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Creating a Euro Area Safe Asset without Mutualizing Risk (Much)

Abstract

This paper explains and evaluates three proposals to create "safe assets" for the euro area based on sovereign bonds, in which sovereign risk is limited through diversification and some form of seniority. These assets would be held by banks and other financial institutions, replacing concentrated exposures to their own sovereigns. The paper focuses on three ideas: (1) to create multitranche "sovereign bond-backed securities" (SBBS), of which the senior tranche would constitute a safe asset; (2) to create a senior, publicly owned financial intermediary that would issue a bond backed by a diversified portfolio of sovereign loans ("E-bonds"); and (3) to issue sovereign bonds in several tranches and induce banks to hold a diversified pool of senior sovereign bonds ("multitranche national bond issuance"). Public attention (including public criticism) has so far focused on the first idea; the other two have not yet been seriously debated. We find that none of the competing proposals entirely dominates the others. SBBS do not deserve most of the criticism to which they have been subjected. At the same time, E-bond and multi-tranche national bond issuance have several interesting features—including inducing fiscal discipline—and warrant further exploration.

JEL-Codes: F330, F360, G210, H630.

Keywords: safe assets, sovereign debt, banking crisis, euro crisis, eurobonds, ESBies, SBBS, E-bonds.

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1. Introduction

Policy proposals to create a common public debt security for the euro area originated in the early days of the euro area crisis and have seen a recent resurgence (Brunnermeier et al. 2017, ESRB 2018, European Commission 2018, Leandro and Zettelmeyer 2018a, 2018c, Giudice et al. 2019). They respond to two main motivations. First, a financial stability concern. Euro area banks tend to be heavily exposed to their sovereign government, while euro area sovereigns are exposed to shocks to their banking sector through both fiscal guarantees (deposit insurance, which remains at the national level) and the impact of banking crises on economic activity. This "doom loop" played a major destabilizing role during the euro crisis, and it mostly remains in place today (Altavilla, Pagano, and Simonelli 2017). The second motivation relates to financial integration, monetary policy, and the external role of the euro. A large, liquid market in euro area debt that does not reflect the sovereign risk of specific member states would help price corporate debt, make it easier for the European Central Bank (ECB) to conduct monetary policy, and increase the attractiveness of the euro as a reserve currency (Monti 2010, Cœuré 2019).

In principle, there are three main approaches to create a euro area safe asset. The first is through collective public guarantees. Euro area sovereigns could jointly issue "Eurobonds," backed by a joint and several guarantee, sharing both proceeds and debt service (De Grauwe and Moesen 2009, Bonnevay 2010). Alternatively, euro area members—or a euro area institution such as the European Stability Mechanism (ESM)—could guarantee portions of the outstanding debt of individual members (Delpla and Weizsäcker 2010, Bini Smaghi and Marcussen 2018).[2] The second involves creating a euro area–level fiscal authority and giving it the right to issue debt, within predefined limits, backed by a dedicated revenue stream (Ubide 2015, Zettelmeyer 2017). The third would create a (senior) financial intermediary, or a regulatory framework for private intermediaries, that would issue debt securities backed by a diversified portfolio of euro area sovereign debt (Monti 2010, Brunnermeier et al. 2011, 2017).[3] The interest collected from these debt holdings would be used to service the debt issued by the intermediary or intermediaries.

[2] See also Christian Hellwig and Thomas Philippon, "Eurobills, not Eurobonds," *VoxEU*, December 2, 2011, available at https://voxeu.org/article/eurobills-not-euro-bonds (accessed on September 24, 2018).

[3] See also Jean-Claude Juncker and Giulio Tremonti, "E-bonds would end the crisis," *Financial Times*, December 5, 2010, available at www.astrid-online.it/static/upload/protected/Junc/Juncker-Tremonti.pdf (accessed on June 11, 2019), and Thorsten Beck, Wolf Wagner, and Harald Uhlig, "Insulating the financial sector from the European debt crisis: Eurobonds without public guarantees," *VoxEU*, September 2011, available at https://voxeu.org/article/eurobonds-without-public-guarantees-insulating-financial-sector-european-debt-crisis (accessed on September 24, 2018).

The purpose of this paper is to explain and compare proposals in this third group. The reason for focusing on this category is not that it necessarily dominates the other two on merits. In particular, there are good arguments for a euro area fiscal authority that would issue a euro area safe asset as a byproduct (Leandro and Zettelmeyer 2018a). However, it is the only approach that may become politically feasible in the foreseeable future. The use of public guarantees has been regularly rejected by euro area sovereigns with relatively strong fiscal positions, such as Germany and the Netherlands, on the grounds that it would lead to free riding and moral hazard (Issing 2009). Creating a euro area budget, on the other hand, requires euro area members both to give up some revenues and spending responsibilities and to establish mechanisms that create democratic accountability at the euro area level.

The paper focuses on three proposals. The first idea, developed by Brunnermeier et al. (2011, 2017), envisages the issuance—by either a public or many private intermediaries—of multitranche debt securities backed by a diversified portfolio of euro area sovereign bonds. The senior tranche of these sovereign bond-backed securities (SBBS), called European Safe Bonds or ESBies, would be sufficiently small, compared to the junior tranches, to make ESBies as safe as a German sovereign bond. This idea has received considerable attention, including an extensive review by a high-level task force of the European Systemic Risk Board (ESRB 2018). Based on this review, the European Commission submitted a legislative proposal to the European Parliament in May 2018, which was adopted, with modifications, in April 2019 (European Commission 2018, European Parliament 2019).[4] At the same time, the idea has been criticized by some commentators, private sector participants, and euro area governments. Critics have argued that the supposed safety of ESBies might turn out to be an illusion if several European countries default at the same time; that there would be little demand for the junior tranches, particularly in a crisis; and that SBBS might sap liquidity from national bond markets, raising sovereign borrowing costs (De Grauwe and Ji 2018, Gabor and Vestergaard 2018).[5]

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[4] See https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2018/0171(COD). The proposed regulation now needs to be considered by the Council before it can become legislation.

[5] See also Academic Advisory Council to the German Federal Ministry of Finance (2017); Marcello Minenna, "Why ESBies won't solve the euro area's problems," *Financial Times*, April 25, 2017, available at https://ftalphaville.ft.com/2017/04/25/2187829/guest-post-why-esbies-wont-solve-the-euro-areas-problems/ (accessed on September 24, 2018); Standard and Poor's (2017); Grégory Claeys, "Make euro area sovereign bonds safe again," *VoxEU.org*, May 2, 2018, available at https://voxeu.org/article/make-euro-area-sovereign-bonds-safe-again (accessed on September 24, 2018); Ferdinando Giugliano, "Europe's 'Safe Bonds' Are Not So Safe after All," *Bloomberg Commentary*, March 22, 2018, available at https://www.bloomberg.com/view/articles/2018-03-22/europe-s-safe-bonds-are-not-so-safe-after-all (accessed on September 24, 2018); Martin Greive, Andrea Cünnen, Frank Wiebe, and Jan Hildebrand, "Staatliche Schuldenmanager gegen neue Euro-Anleihen," *Handelsblatt*, January 29, 2018; and Wolfgang Münchau, "Eurozone reformers act as if the crisis never happened," *Financial Times*,

The other two ideas are less well known. Their common element, compared to the SBBS proposal, is that they would reverse the order of tranching and diversification. In the first variant, referred to as the E-bond proposal (Monti 2010, Leandro and Zettelmeyer 2018b, Giudice et al. 2019), a senior euro area public financial intermediary, such as the ESM, would lend fixed amounts to each euro area member state as a proportion of its GDP (and possibly the size of its outstanding debt). Seniority could be established through both statute (such as a revised ESM treaty) and contract, by subordinating newly issued sovereign bonds to loans from the financial intermediary. The loans would be financed by issuing bonds—"E-bonds"—backed by the diversified portfolio of loans. By conservatively setting the maximal amount that the E-bond issuer would lend to each member, E-bonds could be made arbitrarily safe.

The second variant has not been previously presented in current form but builds on Wendorff and Mahle (2015) and Leandro and Zettelmeyer (2018a). It is best described as an alternative way of implementing the E-bonds idea. Rather than creating a de facto tranching of sovereign debt by issuing a portion of sovereign debt as loans from a senior intermediary, each member state would issue debt securities in two or more tradable tranches. The size of the senior tranche relative to the junior tranche(s) would be the same as the size of the loans of the E-bond issuer relative to the bonds that each member would continue to issue to the market. The senior tranches could subsequently be bundled by private intermediaries (along the lines of the SBBS proposal), who would issue single-tranche securities backed by these portfolios. Alternatively, euro area banks could be required to hold diversified portfolios of the senior tranche directly.

Conceptually, the three ideas are close cousins. All aim to create "safety" by combining diversification of the underlying sovereign risk with seniority. But the way these ingredients are combined and implemented institutionally differs, giving rise to surprisingly different properties. Although all proposals can be calibrated, using a sovereign default simulation model, so that the expected loss rate of the "safe" asset that they generate is the same, they differ with respect to their losses in catastrophic, but low-probability, crises. One of the three proposals, E-bonds, would give rise to redistribution across countries, albeit in very small amounts, whereas the other two would be redistribution-free by construction. E-bonds require a public issuer, whereas both SBBS and safe assets derived from senior bonds issued at the national level could be implemented by competitive, regulated

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February 28, 2018, available at https://www.ft.com/content/b55e37f0-1326-11e8-8cb6-b9ccc4c4dbbb (accessed on September 24, 2018). In a June 2018 "French German roadmap for the Euro area", the French and German ministries of finance stated that "The Commission proposal for Sovereign Bond Backed Securities (SBBS) has significantly more disadvantages than potential benefits and should not be further pursued" (see https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Europe/Articles/2018-06-20-Meseberg-att1.pdf;jsessionid=7A197F85F6BF2D32E1A20A01F7FF3422?__blob=publicationFile&v=3; accessed on September 24, 2018). For a less critical view, see Goldman Sachs (2018).

private entities. SBBS are designed not to raise the marginal cost of sovereign debt issuance above the average cost, whereas both E-bonds and safe assets derived from senior national bonds would, as extra issuance would occur via subordinated instruments. However, the average debt cost would not rise, as the lower cost of senior debt would offset the higher cost of subordinated debt.

The legal and practical complications of the three proposals also differ widely. Privately issued ESBies and safe assets derived from senior bonds issued at the national level require a legal framework that would regulate private intermediaries. This is complex, particularly in the case of ESBies. E-bonds do not require such regulation but instead an enforceable legal framework that ensures that sovereigns respect the seniority of the E-bond issuer, from whom they would borrow.

The remainder of this paper presents and analyzes the three proposals in sequence. The main economic properties of each proposal are analyzed first, followed by a description of possible legal and practical complications and then a quantitative comparison of the tail risks of the safe assets that would be generated under each proposal. A concluding section distills the takeaways.

2. Proposals

A. SBBS/ESBies

Brunnermeier and colleagues (2011, 2017) proposed the creation of a European Senior (or Safe) Bond based on a combination of diversification and tranching. A financial intermediary would purchase a diversified pool of sovereign bonds at market prices, financed by issuing securities whose payoffs would be the joint payoffs of the bonds in its portfolio, and issue sovereign bond-backed securities (SBBS) backed by this cover pool. The weight of each country's bonds in the portfolio would be set, by regulation, to correspond to the capital key of the ECB (which in turn reflects the relative size of nominal GDP and population), except that countries with very small debt stocks would be excluded or "underweight," while the remaining countries would be "overweight."[6]

In the version of the proposal adopted by the European Parliament in April 2019, SBBS issuers would be private entities whose sole function would be to issue SBBS in two or more tranches (e.g., senior, mezzanine, and junior or "equity"), purchase the corresponding cover pool, distribute its proceeds among

[6] The portfolio weights cannot exactly equal the ECB capital key, because the total volume of the cover pool would in that case be severely constrained by the sovereign debt outstanding in low-debt countries, particularly Estonia, which in 2018 had just €48 million in outstanding central government debt securities (0.2 percent of GDP). Estonia's ECB capital share is 0.28 percent. Hence, if the ECB capital key were to literally apply to the composition of the SBBS cover pool, the maximum SBBS volume would be 48/0.0028 = €17 billion, which is just 0.24 percent of euro area central government debt.

investors, and exercise formal creditor rights in a restructuring event (albeit under instructions; see below). To avoid injecting any risk into the system beyond the underlying sovereign risk, SBBS issuers would be legally separate from the firms that own them and avoid any of the risks associated with market making (cover pool purchases would be based on an order book, avoiding "warehousing risk").

In any given payment period, payments to investors would observe a waterfall structure: the proceeds of the cover pool would first be used to meet the claim of the senior tranche holders, then those of the mezzanine tranche, and finally those of the junior tranche. Any cash flow volatility would thus be passed on to securities holders in line with the contractually prescribed hierarchy of claims.[7] Hence, nonpayment by any sovereign issuer to the SBBS issuer would not constitute a default of any of the SBBS, even if the underlying sovereign bond were in default. Instead, it would trigger a predefined procedure for recovery of the underlying debt instrument. The riskiness of the senior tranche would therefore depend on the "thickness" of the subordinated tranches relative to the total SBBS volume (the "subordination level"): The higher the subordination level, the lower the claims of the senior tranche compared to the total claims, and the larger the cushion protecting the senior tranche from sovereign default. Using a two-level default simulation model,[8] Brunnermeier and colleagues (2017) argue that achieving a five-year expected loss rate as low as that of a German bund (0.5 percent in the adverse calibration of their model) would require a subordination level of about 30 percent. Based on these calculations, both ESRB (2018) and the EU regulation currently under consideration assume that the senior tranche would comprise 70 percent, the junior (equity) tranche at least 5 percent, and the mezzanine tranche the remainder.

Main Properties

Table 1 investigates the volume and safety of the SBBS senior (upper 70 percent) tranche under three alternative assumptions about the composition of the pool. Cases A and B are based on the legislative resolution recently passed by the European Parliament (2019), which stipulates that countries with illiquid

[7] Unlike typical mortgage-backed security (MBS) structures, the issuer would not attempt to advance coupon payments regardless of the performance of the underlying assets. In MBS structures, these advances tend to be recovered by making the issuer "super-senior" at maturity. ESRB (2018) rejects this feature on the grounds that it would make the senior tranche less safe. The EU regulation proposal defines the hierarchy of payments as follows (Article 6, 5-6): "Payments under an SBBS shall be dependent upon the payments of the underlying portfolio of sovereign bonds. The distribution of losses and the order of payments shall be determined by the tranche of the SBBSs issue and shall be fixed for the entire life cycle of the SBBSs issue. Losses shall be recognised and assigned as they materialise." See European Parliament (2019).

[8] The first level simulates 2,000 five-year periods, in each of which the economy can be in three states: an expansion, a mild recession, or a severe recession. The three states differ in terms of default probabilities and loss-given-default rates. The second level determines whether one or several countries default, conditional on the state determined in the first level. Two calibrations are used: a benchmark in which probabilities of default and loss-given-default parameters are assumed to be consistent with bond yields and credit default swap (CDS) spreads at end-2015 and historical averages, and an adverse calibration which assumes much higher cross-country correlations in default probabilities. See Brunnermeier et al. (2017) and Leandro and Zettelmeyer (2018a).

central government debt markets are to be excluded from the SBBS cover pool. We assume that this would apply at least to Estonia, which has almost no sovereign bonds outstanding. In addition, the legislative resolution allows an absolute maximum deviation of up to 10 percent between the share of each country's central government debt in the cover pool and its share in the ECB capital key. Case A makes full use of this flexibility, "underweighting" the smaller debt issuers as much as possible and "overweighting" the remainder. Even so, the maximum volume of the cover pool remains heavily constrained by countries such as Latvia, Lithuania, and Greece, whose shares of euro area sovereign bonds are small compared to their share in the ECB capital key: column 5 shows that the total size of the cover pool would be €920 billion, implying safe assets (senior SBBS tranches) of about €640 billion, which is just under 6 percent of euro area GDP. Even excluding Estonia, Latvia, Lithuania, and Greece from the cover pool (Case B) would allow only €950 billion in senior SBBS, about 8 percent of euro area GDP. This is less than half of the euro area sovereign bonds currently held in euro area bank balance sheets (about 17 percent of euro area GDP).

Generating a sufficiently large volume of senior SBBS to replace sovereign bonds in euro area bank balance sheets—and leave some for other financial institutions, such as insurance companies and pension funds, that currently hold euro area sovereign bonds—would thus require a much more flexible approach to the SBBS portfolio composition than currently stipulated in the legislation resolution. Case C shows one such example. This case constrains the SBBS cover pool in two ways.

First, we follow ESRB (2018) in using the purchase limits of the ECB's Public Sector Purchase Programme (PSPP) as a guidepost. The maximum shares of outstanding debt purchased by the ECB as part of the PSPP are 33 percent of each member state's eligible debt and 50 percent of the debt of supranational institutions such as the ESM. According to the ECB, these limits are "a means to safeguard market functioning and price formation as well as to mitigate the risk of the ECB becoming a dominant creditor of euro area governments."[9] Since the latter concern does not apply to SBBS issuers (which in the event of a debt restructuring would be acting on the instructions of the SBBS holders, as explained below), we take the 50 percent purchase limit as the relevant one. Furthermore, for countries with very large debt markets—Italy, Germany, and France—we allow the 50 percent limit to be exceeded, so long as at least €200 billion of tradable debt remain in the market, on the grounds that liquidity as measured by bid-ask spreads appears to be lower for markets with a volume of less than €200 billion, but not more (see Leandro and Zettelmeyer 2018a for details).

[9] See ECB, "Public sector purchase programme (PSPP) - Questions & answers", https://www.ecb.europa.eu/mopo/implement/omt/html/pspp-qa.en.html (accessed on 15 July 2019).

Second, we allow deviations from the ECB capital key to exceed the +/− 10 percent limit stipulated by the legislative resolution so long as the overall deviation, measured by the root mean squared error of the resulting portfolio weights from the ECB capital key, does not exceed the overall deviation under the PSPP as of end-2018 (about 0.9 percentage point), when the ECB was also trying to (more or less) match the ECB capital key. In other words, we take the deviations observed for the PSPP as a measure of the tolerance of the Eurosystem toward technically motivated deviations from the capital key.

Column 9 of the table shows that, under these assumptions, a much higher volume of senior SBBS could be generated, about €2.5 trillion, or 21 percent of euro area GDP. Column 10 confirms that the cover pool's portfolio weights would still be broadly in line with the ECB capital key.

How risky would the senior tranche be in terms of expected losses? In Brunnermeier et al. (2017), a subordination level of 70 percent was set, given a broadly similar set of portfolio weights, to achieve a five-year expected loss rate of 0.5 percent, which (based on the adverse calibration of their model) corresponds to the five-year expected loss rate of the German bund (see column 3). The memorandum items of table 1 show this expected loss rate, recomputed for each case, using the same model. As expected, it is still close to 0.5 percent.

Two further properties of SBBS concern their redistributive implications and their potential impact on the sovereign debt market. Unlike proposals to create common euro area safe debt using guarantees by member states, SBBS are designed to avoid any redistribution among the countries included in the cover pool. Any losses due to sovereign defaults or debt restructuring would simply be passed on to the holders of various SBBS tranches in the prescribed order. Furthermore, since national sovereign bonds would not be subordinated to any of the SBBS tranches (the tranches only establish a seniority ranking among themselves), SBBS should not increase the marginal cost of issuance, except possibly to the extent that they reduce market liquidity by taking a portion of sovereign debt out of the market. The rules governing inclusion in the SBBS cover pool are intended to mitigate this risk. To the extent that SBBS help reduce crisis risks associated with the sovereign exposure of banks, they could of course lower country risk, and hence sovereign borrowing costs. This would be an intended effect and not a source of moral hazard.

Complications

While SBBS are conceptually simple, creating an SBBS market that meets the desired objectives and minimizes the risk of unintended consequences requires a complex structure:

1. To the extent that SBBS intermediaries are private entities, as proposed by the European Commission (2018) and the European Parliament (2019), they must be regulated to ensure that they are indeed robotic entities that do not expose SBBS holders to extra (nonsovereign) risk.

2. To be liquid, SBBS should be as homogeneous as possible both across different SBBS in terms of the country composition of the cover pools and within each SBBS in terms of the characteristics of the underlying bonds. This requires setting a standard for the composition of the SBBS cover pool. It may also require coordination among sovereign issuers to ensure that the requisite bonds are available for purchase.
3. To address the frequently voiced concern that the junior SBBS tranche might not find buyers in a crisis—potentially blocking the entire SBBS production pipeline[10]—bonds in the SBBS cover pool must receive the same treatment in a debt restructuring as bonds held directly by investors, and countries that lose market access should be excluded from the cover pools of new SBBS.[11] The latter implies that on occasion (namely, following sovereign debt crises) the composition of the SBBS cover pool will differ slightly.
4. SBBS holders must have adequate representation in a sovereign debt restructuring. Technically, the owner of the sovereign debt security is the SBBS issuer; however, since this issuer is simply a conduit for cash flows—it has no "skin in the game"—it has no incentive to negotiate in the way that bond holders usually would, namely, to maximize the recovery value of the debt.

The text adopted by the European Parliament (2019) seeks to address the first three points, at least to some extent. Point 1 (regulation of intermediaries) is addressed at length in Articles 7 and 8, which set out the obligations of the intermediaries and their investment policies. These articles state that the intermediaries' activities should be limited to issuing and servicing SBBS and require the segregation of their own assets and financial resources from those of the underlying SBBS portfolios. In addition, intermediaries are allowed to invest payments of principal or interest from the underlying sovereign bonds that are due before payments to the holders of SBBS only in cash or other highly liquid assets.

To address point 2, homogeneity of SBBS across issues, the legislative resolution regulates the country weights in the SBBS cover pools (they cannot deviate from the ECB capital key shares by more than 10 percent), while allowing for the exclusion of particular countries from the cover pool under certain circumstances (loss of market access, illiquidity, or when their sovereign bonds are unavailable in

[10] See Academic Advisory Council to the German Ministry of Finance (2017) and Standard and Poor's (2017), among others.

[11] These conditions may be not be necessary to ensure that SBBS never lose market access, but together with the condition that SBBS intermediaries do not introduce nonsovereign risk, they are jointly sufficient. To see this, suppose that all bonds in the SBBS cover pool enjoy market access and that the riskiness of the SBBS reflects only the risk of the sovereign bonds in that cover pool. If the SBBS (or any tranche thereof) nonetheless does not have market access, it would be possible to achieve large arbitrage profits by selling euro area sovereign bonds and using the proceeds to purchase an SBBS portfolio at a near-zero price, leading to an identical expected payment stream.

the market). It also requires the difference in the maturities of the underlying bonds of a given SBBS issue to be no greater than six months. However, the legislative resolution is silent on the important issue of coordinated issuance of sovereign bonds to ensure the availability of the required bonds. In the absence of coordinated issuance, SBBS issuers would need to purchase some bonds on the secondary market. If this is not feasible at exactly the time when SBBS are issued, these bonds will need to be either bought in advance—injecting "warehousing risk" into the system—or excluded from the cover pool, which would reduce the homogeneity of different SBBS issues.

Point 3, SBBS market access, is addressed by a provision that would require the European Securities and Markets Authority to notify the European Commission when any country loses market access, which would result in the exclusion of that country's bonds from the SBBS' underlying portfolio (Article 4.3a). To prevent discrimination against bonds held by the intermediary in the case of a sovereign debt restructuring, Article 7.4a states that "Member States shall ensure that holdings of sovereign bonds by SPEs [intermediaries] enjoy the same treatment as any other holdings of the same sovereign bond or of other sovereign bonds issued with the same terms."

With respect to the final point, SBBS holder representation in a debt restructuring, the legislative resolution is silent. In effect, any losses that the SBBS cover pool might suffer are taken as a given: the fact that debt restructuring outcomes might influence those losses—and hence that SBBS holders might have an interest in influencing that outcome—is ignored. This makes sense if only a very small portion of the debt is held in SBBS cover pools: in that case, exercising the voting power of the SBBS cover pool would not make a difference, and whether and how SBBS intermediaries vote on a proposed modification of payment terms is irrelevant. However, this also means that the volume of SBBS would be so small as to be irrelevant.

For SBBS to make a difference, a significant fraction of the bond market would need to be held in the cover pool. In that case, the exercise of the associated voting rights would be expected to have an impact on the outcome of a debt restructuring. SBBS intermediaries should therefore be required to vote following instructions that maximize the interests of the SBBS holders collectively. As explained in detail by ESRB (2018), this could be achieved by (1) tasking an independent trustee to provide such instructions (one for each SBBS issue, or perhaps for all SBBS issues whose cover pools contain some debt to be restructured), or (2) requiring the SBBS issuers to follow instructions issued by holders of the "marginal" SBBS tranche, that is, the tranche whose losses are expected to be strictly greater than zero but lower than

100 percent.[12] In the first case (trustees), the regulation would need to lay out requirements for such trustees, and state whether there should be one or many trustees. In the second case, the regulation would need to specify a procedure for translating votes from holders of the marginal SBBS tranche into voting instructions to the SBBS issuer, and of course for deciding which SBBS tranche should be considered marginal.[13] Since the latter will depend on the expected loss given default,[14] this may in turn require some delegation to an independent entity or trustee.

Some of these complications could be avoided by creating a public SBBS intermediary, an option left open by the ESRB (2018), but (implicitly) rejected by the European Commission (2018) and the European Parliament (2019). A public intermediary would obviate the need for regulation, might help coordinate bond issuance, and could perhaps even absorb some warehousing risk (if endowed with some amount of capital). This said, some of the problems that regulation of private intermediaries tries to solve—to ensure that the intermediary does its job and no more than its job, and does not create risks—would continue to exist and would have to be addressed through other means (a clearly defined mandate and governance structure). Furthermore, the need to represent the interests of SBBS holders in a debt restructuring, to resolve conflict of interests across SBBS tranches, and to ensure that bonds held in the SBBS cover pool are treated the same way as bonds held directly by investors would continue to arise. Perhaps more importantly, one of the charms of the SBBS proposal is precisely that although it admits a public intermediary, it does not require it and so can, in principle, be supported by member states that fear that public issuance of euro area safe assets could give rise to implicit guarantees.

B. E-bonds

As in the SBBS approach, an intermediary would hold a portfolio of government debt and issue securities—"E-bonds"—backed by this portfolio (Monti 2010; Leandro and Zettelmeyer 2018a, 2018b; Giudice et al. 2019). Unlike SBBS, however, E-bonds would be issued as a single tranche. Like ESBies,

[12] Allowing the holders of other tranches to give instructions may run counter to the collective interest of SBBS holders to maximize total recovery value, because changes in the terms of the debt restructuring may not influence the losses suffered by these holders. For example, if the mezzanine tranche is marginal, then both the junior and senior tranche holders might agree to a restructuring that is deeper than necessary, since the former are wiped out anyway while the latter are repaid in full anyway.

[13] See ESRB (2018), Volume II, section 2.2.3 for details.

[14] The marginal tranche is usually the junior tranche, but in some cases—if debt restructurings affect a large share of the cover pool, and losses given default are high enough—it could be the mezzanine or even the senior tranche. For example, assume that the face value of the junior tranche is 5 percent of the total and consider a debt restructuring that affects a single large sovereign, such as Germany (26 percent of the portfolio) or Italy (17 percent of the portfolio). If the loss given default for Germany or Italy is 15 percent or 30 percent, respectively, then the junior tranche is marginal. If it is 20 percent and 35 percent, however, the mezzanine tranche is marginal (given the respective portfolio shares, these losses given default imply overall losses of more than 5 percent).

this would be made safe through a combination of diversification and seniority, but seniority would apply at the level of the intermediary issuing the E-bonds, which would have preferred creditor status. For this reason, the intermediary would need to be a public entity. The E-bond intermediary could be equipped with (small) levels of capital to create even safer assets; however, this is not an essential feature. In a barebones design, any losses suffered by the E-bond issuer would be passed on to the holders of E-bonds, just as any losses suffered by SBBS intermediaries would be passed on to SBBS holders.

In principle, the intermediary could fund governments at market interest rates or at some other interest rate. In the first case, it would be purchasing bonds in the primary or secondary markets (as in the SBBS approach); in the latter, it would be originating loans. Because of the intermediary's preferred creditor status, purchases at market prices would lead to large profits over time. If redistributed to sovereigns in proportion to their borrowing (or alternatively, a capital key), this would imply large net transfers from countries with high borrowing spreads to countries with low spreads, since the market prices of high-spread countries reflect far higher risk than is borne by the senior E-bond intermediary (Leandro and Zettelmeyer 2018a). Since higher-spread countries tend to be poorer, this is politically implausible. This paper therefore focuses on the second possibility, in which the intermediary extends loans at a uniform interest rate that covers its funding and operating costs. The ESM currently operates along similar lines, except that it lends only to crisis countries, whereas the E-bond intermediary would lend to all euro area sovereigns. Because all borrowers would face the same interest rate, this implies expected transfers in the opposite direction, from lower-risk to higher-risk countries. However, as will be shown below, these transfers would be small in magnitude, because the risk that would be redistributed would be low (thanks to the E-bond issuer's preferred creditor status).

The riskiness of E-bonds depends on the riskiness of the loan portfolio held by the E-bond issuer, which in turn depends on the share of each sovereign's debt that it holds. If the share is low, this means that the share of subordinated market debt (the subordination level) is high relative to the volume of senior loans. This implies a high level of protection for the E-bond holders, as the E-bond issuer can lose money only if the country's sovereign bond holders receive nothing at all. Hence, the volume that the E-bond issuer lends to each country will determine both the total volume of E-bonds (equal to the size of the cover pool, since E-bonds are issued in one tranche) and the riskiness of E-bonds, by determining the composition of the cover pool and the subordination levels for each country.

How would the level of lending of the E-bond issuer to each euro area sovereign be decided? One possible answer is to choose the lending portfolio that would maximize the volume of E-bonds subject to attaining a specific safety level (e.g., a 0.5 percent five year expected loss rate, as in the SBBS proposal). This can be generated through the following recursive approach. Start by replacing as much German debt

as possible—that is, right up to the limit dictated by the authorities' desire to maintain a liquid bond market—with loans from the E-bond issuer. E-bonds would then be safer than current German debt, since they would be backed only by German debt and protected by a cushion of junior German bonds. Repeating this step for the next safest country would slightly lower the safety level of E-bonds, and so on, until the desired safety level is reached.

The problem with this approach is that it would lead to portfolio weights that are very far from the ECB capital key, as E-bonds would be backed mainly by loans to Germany and other lower-risk countries, while countries with less safe bonds would be greatly underweighted. This approach would thus likely be politically unfeasible. Instead, it is assumed that E-bonds would be constructed using either of the two following approaches:

- *One-limit rule based on GDP*. Following Giudice et al. (2019), the E-bond issuer could simply lend the same share of GDP to each member, with the GDP share calibrated to achieve the desired safety level (the lower the share, the larger the subordinated cushion of bonds held by market participants, and the safer the E-bond).[15] In table 2, we show that this would lead to a portfolio that is fairly close to the ECB capital key.[16] This approach implies that for countries whose share of sovereign bonds in GDP is below the limit, sovereign debt markets would disappear entirely. This is not ideal for two reasons. First, as discussed previously, sovereigns may have a desire to maintain some traded debt—for example, to allow financial markets to price country risk. Second, there would be no protective cushion of subordinated debt in those countries, meaning that any default—even with very small losses given default—would lower the payments to E-bond holders.
- *Two-limit rule based on GDP and central government debt outstanding*. Alternatively, the E-bond issuer could observe *two* lending limits: one expressed as a share of GDP and one as a share of total central government debt (Leandro and Zettelmeyer 2018a). In other words, lending from the E-bond intermediary to country i, denoted P_i^E, would be

$$P_i^E = \min\{yY_i\,, cD_i\},$$

[15] We also follow Giudice et al. (2019) in assuming that countries cannot be forced to borrow more from the E-bond issuer than their current outstanding debt, implying that the GDP-based rule is in fact a two-limit rule, with outstanding government debt securities constituting the second upper limit. However, the second limit turns out to be binding for only two countries: Estonia and Luxembourg (see table 2). Because the debts of these countries are small, relaxing this assumption (i.e., assuming that their borrowing from the E-bond issuer is the same, as a share of GDP, as that of all other countries) makes almost no difference to the results (see footnote 17).

[16] It does not quite correspond to the ECB capital key because the latter is based on population as well as GDP.

where Y_i denotes GDP, D_i the stock of central government debt, and y and c purchase limits as a percentage of GDP and debt, respectively (for example, 20 percent of GDP and 50 percent of debt). While these limits would be the same for all countries, they could be set to maximize the total volume of purchases, subject to (1) achieving a desired safety level and (2) not deviating from the ECB capital keys by more than the ECB's PSPP (as discussed in the previous section).

Main Properties

Table 2 shows the volumes that the E-bond issuer would lend to each country based on each of the lending rules described above, assuming that the desired safety level is the same as previously assumed for the SBBS approach: a 0.5 percent five-year expected loss rate, computed using the Brunnermeier et al. (2017) default simulation model. For the one-limit rule, this generates a loan share of 18.7 percent of GDP. This implies that the E-bond issuer would hold 100 percent of the sovereign debt of Luxembourg and Estonia (since their sovereign debt stocks are 14 and 0.2 percent of GDP, respectively; see column 2 of table 1), 57 percent of German sovereign debt, 26 percent of French sovereign debt, and 18 percent of Italian sovereign debt (table 2, column 3).

Under the two-limit rule, the loan amount that maximizes the E-bond volume subject to achieving a five-year expected loss rate of 0.5 percent is 22.8 percent of GDP or 52.5 percent of central government debt, whichever is smaller. The fact that the GDP limit is slightly higher in the two-limit rule reflects the presence of the second limit. Ceteris paribus, this reduces the riskiness of the E-bond, since it implies that, for every country, there will be a substantial cushion of subordinated market debt that protects the E-bond issuer from default. To achieve the same overall safety level as in the one-limit case, the GDP-based lending constraint can hence be somewhat relaxed. Whether the GDP constraint or the debt constraint is binding for any given country depends on whether outstanding sovereign debt is higher or lower than 22.8/52.5 = 43.4 percent of GDP. Germany, for example, has only 33 percent of GDP in central government bonds outstanding, so the debt constraint is binding; the intermediary lends debt corresponding to 52.5 percent of the current sovereign debt stock to Germany, which represents 17.4 percent of GDP. Italy's sovereign bonds are about 106 percent of GDP, so the GDP constraint is binding and the intermediary issues loans worth 22.8 percent of Italian GDP, corresponding to 21.5 percent of the sovereign debt stock.

Columns 5 and 11 of table 2 show the implicit subordination levels, i.e., the share of subordinated bonds in total sovereign debt. For the one-limit lending rule, these range from 0 (Estonia and Luxembourg) to 82.3 percent (Italy). For the two-limit version, the lower bound is 47.5 (all countries with sovereign debt of less than 43.4 percent of GDP) and the upper bound 78.5 percent (Italy). Columns 6 and

12 show the corresponding expected losses from the perspective of the E-bond issuer. Reflecting the seniority of the E-bond issuer, these are much smaller than the country expected losses shown in table 1. For a half-dozen highly rated countries—Germany, the Netherlands, Austria, Finland, France, and Belgium—they are even zero, because the subordination levels for those countries turn out to be higher, under both lending rules illustrated in table 2, than the maximum losses given default assumed by Brunnermeier et al. (2017).

The main result of table 2 is that the volume of safe assets that can be generated by the E-bond approach—defined as securities with a five-year expected loss rate of 0.5 percent based on the Brunnermeier et al. (2017) model, to make the results comparable with those of table 1—is about €2.2 trillion using the one-limit rule, and €2.4 trillion using the two-limit rule.[17] These amounts are much higher than the volume of ESBies that could be created based on the European Parliament's SBBS legislative resolution (less than €1 trillion), and about the same as the maximum amount of ESBies (€2.5 trillion) that could be generated under the more flexible approach (Case C in table 1).

In contrast with the SBBS approach, in which the issuer receives interest that reflects borrowing risk, the E-bond issuer would charge the same interest to all its borrowers. Since these are not equally risky, this implies some long-run redistribution among euro area countries. But how much? Table 3 uses the Brunnermeier et al. (2017) default risk model to answer this question for the two lending rules analyzed in table 2. For each lending rule, the left columns—(1) for the one-limit rule; (6) for the two-limit rule—restate the volume of lending from the E-bond issuer to each country. The adjacent columns show the five-year expected loss rate faced by the intermediary from each country's loans under the benchmark calibration of the Brunnermeier et al. (2017) default model. The reason for using this calibration as opposed to the adverse calibration used in table 2 is that table 3 focuses on expected redistribution rather than a worst-case outcome.[18] The multiplication of the elements of columns (1) and (2) and columns (6) and (7) gives the expected loss in € billion attributable to each country under either of the two lending rules; this loss is shown in columns (3) and (8), respectively. The sum of expected losses over a five-year period is about €10 billion in both cases.

[17] Relaxing the assumption that borrowing from the E-bond issuer cannot exceed the stock of outstanding central government debt securities changes the results as follows: loans to Estonia would increase by €4.8 billion and loans to Luxembourg by €2.8 billion. This implies that the volume of E-bonds would increase from €2,161.5 billion to €2,169 billion. Assuming that the expected losses of Estonia and Luxembourg remain the same notwithstanding their slightly higher debt stocks, the resulting five-year expected losses on the E-bond portfolio would be virtually unchanged (0.54 percent).

[18] That said, the differences are not that big, as can be seen from comparing columns (2) and (7) in table 3 with columns (6) and (12) in table 2.

These expected losses will be reflected in the funding costs of the E-bond intermediary, which are passed on to sovereign borrowers via a uniform lending rate. Multiplying each borrower's portfolio share (shown, for each of the two lending rules, in columns 4 and 10 of table 2) with the total expected loss gives the amount of the five-year expected loss absorbed by each borrower (columns (4) and (9), respectively, of table 3). The difference between the expected loss caused and the expected loss absorbed is the expected transfer, shown in columns (5) and (10). If this number is positive, it means that the country is receiving a transfer in expectation; if it is negative, the country is paying a transfer. The total volume of expected transfers over five years equals the sum of the positive entries in columns (5) and (10) (or equivalently, the absolute value of the sum of negative entries, which are the source of finance for the positive entries). For the one-limit rule, this is on the order of €8 billion over five years; for the two-limit rule, on the order of €7.5 billion, or about €1.5 billion per year. In relative terms, this is not high (less than 1 percent of the annual EU budget), reflecting the fact that, due to its seniority, the E-bond issuer does not bear much sovereign risk.

As expected, redistribution would occur mostly at the expense of Germany and France, who do not contribute to the riskiness of the intermediary but pay a large share of the issuer's funding cost (for the two-limit rule, €2.48 and €2.25 billion, respectively, over five years). Redistribution would benefit Greece (€4.35 billion over five years in the two-limit case) and to a lesser extent Spain (€1.34 billion) and Portugal (€0.56 billion). Italy, however, would be a net contributor. This reflects the imposition of a GDP-based lending limit under both lending rules considered in tables 2 and 3. As a result, the share of Italian sovereign debt held by the E-bond issuer would be the lowest of all countries, while the subordination level—the cushion of subordinated Italian debt protecting the E-bond issuer—would be the highest (about 80 percent; table 2, column 11). Thus, from the perspective of the E-bond issuer, lending to Italy would be virtually risk-free.

These results partly reflect the calibration of the Brunnermeier et al. (2017) model using end-2015 credit default swap (CDS) spreads. If end-2018 CDS spreads were used, transfers to Greece—as well as total transfers—would be smaller. The main results, however, are robust to such a recalibration: there would be a transfer, it would be small compared to the volume of contributions to the EU budget, and the largest contributors would be Germany and France. The result that Italy would be a net transfer provider rather than a recipient is also likely to be robust, as it depends only on the assumption that the worst-case loss given default for Italy is less than the subordination level of about 80 percent.

Because E-bonds would give rise to some (albeit modest) redistribution benefitting countries with higher fiscal risks, it is natural to ask whether they would create moral hazard, i.e., weaken fiscal discipline in these countries. The answer is no, because the cost of borrowing from the market would rise

as a result of the fact that sovereign bonds are now subordinated to loans from the E-bond issuer. Because E-bond volumes would be capped, the only way to expand borrowing would be to issue more bonds to the market, which would be subordinated to the loans from the intermediary. Hence, the marginal cost of borrowing would rise compared to the status quo.

The magnitude of this effect is shown in table 4, assuming the two-limit lending rule (the results for the one-limit rule are similar and shown in appendix A). In columns (5) and (9), the table shows the difference between the marginal cost of borrowing if bonds were subordinated to senior loans, for the subordination levels shown in column (1), and the current marginal cost of borrowing (i.e., without subordination) using two different methodologies. In both cases, we assume that interest parity holds, that is, that yields of subordinated bonds would increase to equalize the expected returns on subordinated and unsubordinated instruments. Columns (2)–(4) and (6)–(8) show the parameter assumptions used to calculate the increase in yields. Both sets of calculations make the same loss-given-default assumptions (see columns (3) and (7), namely, the average losses given default implicit in the Brunnermeier et al. 2017 sovereign default model). For sovereign defaults, these are realistic, albeit conservative numbers. For example, the 2012 Greek debt restructuring led to creditor losses, in net present value terms, of about 60–65 percent (see Zettelmeyer, Trebesch, and Gulati 2013 and, for a sweeping historical overview, Meyer, Reinhart, and Trebesch 2019). Based on these overall loss-given-default (LGD) assumptions, denoted l, the loss-given-default for holders of a subordinated bond is computed as $l_s = \min\{1, l/s\}$ where s is the subordination level. For example, if l is 50 percent and s is 80 percent, then the total loss of 50 percent must be shared among 80 percent of the debt holders, so l_s, the loss given default for the subordinated bond holders, is $5/8$, or 62.5 percent. If the loss given default is 50 percent but the subordination level is 50 percent or less, then $l_s = 1$, i.e., subordinated debt is "wiped out."

The difference between the two methodologies lies only in how the default probability p is estimated: in column (2), this is based on the Brunnermeier et al. (2017) default simulation model—which in turn was calibrated using end-2015 CDS spreads; in column (6) it is based on April 2019 observed market yields (see appendix B for details). This has some impact on the estimated rise in yields, but the differences are not dramatic. German sovereign bond yields would hardly budge, while the bond yields of other highly rated countries would go up by about 10–30 basis points. The impact on the lower-rated countries would be a bit higher, on the order of 40–80 basis points, with only Greece above that range.

Importantly, the fact that the marginal borrowing cost goes up for all countries does not mean that the overall, or average, borrowing cost goes up. On one hand, market borrowing becomes more expensive, but on the other, countries now have access to a low-cost borrowing source, namely, the E-bond issuer. We have shown that these effects roughly offset each other (Leandro and Zettelmeyer 2018a). They do

not *exactly* offset each other only because of the presence of transfers.[19] Thus, the average borrowing cost of Germany and other highly rated borrowers ends up being slightly higher than in the status quo, while the average borrowing cost of Spain, Portugal, Cyprus, and Greece—countries that are the beneficiaries of net transfer—drops slightly. This is easiest to see for Germany: whereas Germany previously borrowed at the bund rate, it now satisfies 52.5 percent of its borrowing needs through lending from the E-bond issuer—on which it still pays the bund rate, since E-bonds are calibrated to be as safe as bunds—and the rest from the market, where borrowing costs are up by 3 basis points (see table 4). Germany's borrowing costs are thus slightly higher (by just under 1.5 basis points). Since euro area fundamentals are assumed to be unchanged, this higher borrowing cost must be offset by lower borrowing costs elsewhere in the system—namely, among the lower-rated borrowers. Importantly, however, the intended effect of E-bonds is to change the fundamentals of the system, through regulation that would encourage banks to hold them as "safe assets." To the extent that this reduces the doom loop between banks and sovereigns and increases the financial stability of the euro area as a whole, it might reduce borrowing costs even in the highly rated countries.

Complications

The E-bond approach avoids most of the complications of privately issued SBBS, albeit at the expense of creating some new ones. Because there are no private intermediaries, there is no need to create a regulatory structure to supervise them and ensure that they do not create counterparty risk. There is no junior tranche, so no regulation is required to ensure it maintains market access. Homogeneity of the E-bond is easy to establish as there is just one issuer. In collaboration with national debt management offices, this entity could match the maturity structure of its loan portfolio with the desired maturity structure of its bond issuance.

The matter of bond holder representation in a sovereign debt restructuring does not disappear entirely but is heavily mitigated by the fact that the "marginal" creditor group almost always consists of bond holders, so debt restructuring negotiations and/or debt exchange offers could proceed as would be the case today (see Buchheit et al. 2019). The only exception is a situation in which the bond holders would be fully wiped out, in which case the E-bond issuer would become the marginal creditor. Because it would be unsuitable for the E-bond issuer to conduct debt restructuring negotiations on behalf of the E-bond holders—both because the issuer is a public sector entity and because it has no "skin in the game," as any losses are passed on to E-bond holders—a mechanism would be needed through which the E-bond issuer

[19] Were it not for the presence of redistribution—and abstracting from any impact of E-bonds on the overall safety of the European financial system—the Modigliani-Miller theorem would hold, which would predict that the overall funding costs of the sovereign should be independent of its capital (financing) structure.

receives instructions from the E-bond holders, along the lines discussed by ESRB (2018) for the SBBS approach.

The main new complication, compared to the SBBS approach, is the need to establish the preferred creditor status of the E-bond issuer in a way that is respected both by euro area sovereigns and by the bond holders subordinated to loans of the E-bond issuer. The first condition requires a change in either the ESM Treaty or EU law that would require signatories/member states that borrow from the E-bond issuer to service these loans before making any payments to bond holders. This obligation would be enforced through the same legal channels as other EU treaty obligations. Immunizing sovereigns from legal action by bond holders may require an additional step, namely contractual subordination. This would have the advantage of covering bonds issued both inside and outside the euro area, whereas an approach based only on treaty or domestic statutes would cover only the former.

Contractual subordination means writing into every sovereign bond contract issued by a euro area sovereign, regardless of governing law, a provision that the bond is subordinated to any past and future claims held by the E-bond issuer. This could be achieved through a modification of the pari passu clause, which would state that the bonds rank equally with all other debts of the state *except* obligations arising from international treaties to which the sovereign is a party.[20]

A final question concerns the transition to the new steady state, in which the central government debt stock of each member would consist only of subordinated bonds and loans from the E-bond issuer. The transition phase would begin with passage of the necessary treaty or treaty change. This would lay out the maximum lending volumes for each country and establish formal seniority of the E-bond issuer with respect to all bonds that are issued after the treaty change goes into effect.

Having established the legal framework, one approach would be to immediately begin issuing new debt in the form of loans and subordinated bonds in their steady state proportions (for example, for Spain, €30 of loans for every €70 units of debt, under the two-limit rule illustrated in table 2). If a debt restructuring were to occur during the transition phase—before existing bonds have been fully replaced – nonsubordinated bonds might need to be restructured to ensure that E-bonds receive the same degree of

[20] Language of this type appears in Italy's 2013 Fiscal Agency agreement with Citibank, written in anticipation of a possible issuance of Italian sovereign bonds under New York law, but apparently never used: "The Securities are the direct, unconditional and general and…unsecured obligations of Italy and will rank equally with all other evidences of indebtedness issued in accordance with the Fiscal Agency Agreement and with all other unsecured and unsubordinated general obligations of Italy for money borrowed, except for such obligations as may be preferred by mandatory provisions of international treaties and similar obligations to which Italy is a party." See Anna Gelpern, "Italy's Pari Passu Scrubbing," April 17, 2013, available at www.creditslips.org/creditslips/2013/04/italys-pari-passu-scrubbing.html (accessed on June 11, 2019).

protection as they would in steady state. As long as the existing bonds have not been subordinated legally (via domestic law or treaty), this approach would likely hold up in court (Buchheit 2018). Importantly, however, the sovereign cannot formally commit to pursuing such a strategy, because doing so could be considered tantamount to legal subordination. Hence, the treatment of the existing sovereign bond stock would have to remain unspecified ex ante, creating uncertainty that may raise the cost of borrowing for the E-bond issuer, and hence the cost of lending to each country, beyond what it would be in steady state.[21]

To address this problem, several options could be explored.

The first is to make the E-bond issuer senior, via treaty or treaty change, without including any language that limits this seniority to bonds issued after the treaty change, thereby subordinating the existing debt stock rather than just new debt. This might be consistent with the pari passu clauses of existing bonds—which prohibit formal subordination of the securities by other debt instruments—as long as loans by the E-bond issuer do not constitute debt instruments within the meaning of these clauses. This would follow the example of IMF loans, which are considered senior without violating the pari passu clauses in government bonds. The caveat is that IMF claims are senior by custom rather than by statute. If the reason why the seniority of the IMF does not conflict with pari passu is that this seniority is not formalized—rather than that IMF loans are not debt obligations in the usual sense but some other kind of claim—then this option will not work. For the reasons explained above (binding euro area sovereigns) it is essential to write the seniority of the E-bond issuer into a treaty signed by euro area members.

A second option is to issue new debt in the form of loans and subordinated bonds in steady state proportions, supported by a legal and institutional structure that ensures that any losses are distributed between old and new debt in proportion to their outstanding volumes. This could look as follows:

1. Each euro area member issues new debt by simultaneously borrowing from the E-bond issuer and issuing to the market with identical maturity, in steady state proportions.
2. Each bundle of new debt issued (and coming due) at the same time is represented by a trustee in a debt restructuring.

[21] Let J denote the new junior bonds, L the senior loans, and O the outstanding, unsubordinated bonds. The steady state subordination level is given by $s = J/(J + L)$. The subordination level during transition, denoted s_t, may be different, however, depending on the treatment of the outstanding bonds. If outstanding bonds are treated the same as junior bonds—i.e., written off before inflicting losses on loans from the E-bond issuer—then $s_t = (J + O)/(J + L + O)$, which is larger than s as long as $O > 0$. If outstanding bonds are treated the same as senior loans, on the other hand, then $s_t = (J)/(J + L + O)$, which is smaller than s for $O > 0$.

3. Trustees are required (by statute or debt contracts) to distribute any proceeds in order of priority (i.e., first to the E-bond issuer and then to the bond holders).
4. The statute (treaty) governing E-bonds commits all euro area governments to offer all trustees the same menu of securities/cash, in the event of a debt restructuring, as to the holders of "old" bonds.

This structure achieves the same degree of protection of the senior sovereign debt tranche (the loan by the E-bond issuer) by ensuring that *in combination*, the new senior and subordinated debt are treated no worse than the outstanding, unsubordinated debt. Hence, the loss that the subordinated bond needs to absorb in order to fully protect the senior debt equals the pro rata losses suffered by the new debt instruments. This implies that the senior debt will be fully protected if and only if the loss given default is smaller than the share of the junior debt in the *new* debt, as opposed to its share in the total debt.

If such a structure were to prove infeasible, an alternative approach would be to begin the transition phase by issuing *all* new debt in the form of bonds that are contractually subordinated to (future) loans from the E-bond issuer. Sovereigns would begin to borrow from the E-bond issuer only after the ratio of existing sovereign bonds to new bonds is equal to the steady state ratio between loans and new bonds. For example, for Spain this point would be reached when the existing (nonsubordinated) bonds have been reduced to about 30 percent of the bond stock. At that point, maturing old debt issues would be replaced by loans from the E-bond issuer, while maturing new bonds would be replaced by new bonds and loans from the E-bond issuer in steady state proportions. The disadvantage of this approach is that it would take a long time before E-bond "production" could even begin—up to 18 years in the one-limit case and up to 14 years in the two-limit case—followed by a gradual increase in the E-bond stock.[22] To accelerate the process once it has started, old bonds could be bought back, financed by loans from the E-bond issuer. To start producing E-bonds immediately, it may be possible to additionally use debt swaps. For example, if the steady subordination level is *s* (e.g., 70 percent, for the example involving Spain), then *s* percent of the old bonds could be retired through a voluntary debt exchange offer involving new bonds, and the rest bought back by loans financed by the E-bond issuer.

[22] These numbers refer to the maximum time until the share of new, subordinated debt in the stock of central government debt securities reaches the steady state subordination level, assuming that the nominal stock of debt remains constant and maturing outstanding debt is replaced by subordinated debt. The country that would take the longest (18 and 14 years for the subordination levels implied by the one-limit and two-limit rules, respectively) is Belgium, because of the high average maturity of its current debt securities stock.

C. Multitranche Sovereign Bond Issuance, Followed by Pooling

There is a third approach, which is conceptually very close to the E-bond proposal but would not require a public intermediary. Euro area sovereigns would commit to issue bonds in several tranches, in proportions laid out by an EU regulation or an intergovernmental treaty (Wendorff and Mahle 2015). To keep the structure analogous to the E-bond proposal, assume that there would be just two tranches: one senior and the other subordinated to all outstanding senior tranches (i.e., not just the senior tranche of the same bond). Any shortfall in payments would be absorbed by all available junior tranches before any senior tranches take a "hit."

In a second step, senior tranches could be pooled to diversify remaining risk. Depending on the objective, this may or may not require a financial intermediary. If the objective is merely to shield banks from sovereign risk, the pooling could be done by the banks themselves, prodded by appropriate regulation that penalizes deviations from ECB capital key weights. In this minimalist version, there would be no homogeneous, tradable common safe asset. Creating a market in such safe assets—for example, to make the euro more attractive as a reserve currency, or to support euro area monetary policy operations—would require financial intermediaries to issue bonds backed by identically composed cover pools of senior tranches. As in the SBBS proposal, but unlike the E-bond proposal, this task could be performed by (regulated) private entities. The reason for this is that seniority in this case is not associated with a specific creditor but rather with the debt instrument itself, which, unlike the loans of the E-bond issuer, would be tradable and priced by the market.

As in the E-bond proposal, the safety of the senior instrument would depend on the subordination level, i.e., the volume of junior tranches as a share of the total debt issued. We have analyzed the case in which all euro area members would set the same subordination level (Leandro and Zettelmeyer 2018a). However, other tranching rules are possible and indeed preferable, in the sense that they could yield a larger aggregate volume of senior debt with the same expected loss rate. Here, we focus on two tranching rules that correspond exactly to the lending rules of the E-bond intermediary analyzed in the previous section. That is, we assume that the volume of senior tranches would be set either as a share of GDP or as the minimum of a given share of GDP and a given share of total central government debt. In the one-limit case, the first 18.7 percent of GDP of debt would be regarded as senior. In the two-limit case, the minimum of 22.8 percent of GDP and 52.5 percent of central government debt would be senior. This would lead to the same volumes of senior tranches as shown in table 2.

In the minimalist version of the multitranche bond issuance proposal, banks would buy portfolios of senior tranches in the primary or secondary bond markets, in the same proportion as in table 2 (i.e., using

the weights of the aggregate portfolio). In the version that aims to create a tradable, homogeneous safe asset, competitive financial intermediaries would buy portfolios of the senior sovereign tranche, using the weights shown in table 2 (set by regulation) in the primary market, financed by issuing one-tranche bonds backed by these portfolios. To maximize the volume of the safe asset, only these intermediaries would be allowed to bid for senior tranches. Because all senior assets would end up in the safe asset cover pools, there would be no secondary market in the senior tranches. To the extent that the volume of safe assets generated in this way exceeds the volume of safe assets that banks and other institutions purchase to hold to maturity, there would, however, be a (liquid) secondary market in the safe asset itself.

Main properties

Since subordination levels and the composition of the cover pool are the same as in the E-bond proposal, so are the volume and the five-year expected loss rates of the assets that can be generated in the multitranche bond issuance proposal (table 2). Furthermore, since junior bond tranches would be subordinated to the senior tranches in the same way as bonds would be subordinated to loans from the E-bond issuer, the computations shown in table 4 also apply to the multitranche bond issuance proposal. With senior debt issuance constrained either by a GDP limit or by both a GDP limit and a debt share, any additional issuance would have to take the form of junior bonds, so columns (5) and (9) of table 4 (and table A1, for the one-limit tranching rule) represent estimates of the change in marginal borrowing costs in the multitranche bond issuance proposal, as well as the E-bond proposal, relative to the status quo.

The main difference between E-bonds and multitranche debt issuance is that the latter would not give rise to redistribution. The reason is that the yield of the senior tranche would differ across countries, reflecting differences in risk—unlike the interest rate that countries would pay to the E-bond issuer, which would be the same for all countries. For the same reason, assuming unchanged fundamentals, average debt costs should be unchanged for all issuers compared to the status quo (i.e., one-tranche issuance). That said, the purpose of the proposal (and of the two preceding proposals) is to strengthen euro area fundamentals, by bolstering the financial stability of the euro area and/or raising world demand for euro area debt through the presence of the safe asset. If that is the case, borrowing costs of euro area issuers should decline.

Complications

One consequence of the multitranche bond issuance proposal is that it would lead to smaller markets in tradable sovereign bonds. The yields of these bonds would be higher than those of today's euro area sovereign bonds, and likely more volatile, because they would be subordinated to senior tranches held in banks or safe asset cover pools, and perhaps because they would be less liquid. However, this is no different from E-bonds, and at least in part an intended consequence of the proposal (to raise market

discipline while keeping average borrowing costs unchanged). The unintended part is that bond yields could become more sensitive to changes not only in country fundamentals but also in market sentiment. In both the E-bond proposal and the multitranche issuance proposal, it is hence essential that countries have reliable access to official liquidity (e.g., through prequalified access to the ESM).

A further complication that the multitranche issuance proposal shares with the E-bond proposal is the transition problem. The choices and trade-offs are the same as in the E-bond case, with one important exception: because the senior tranches are debt instruments held by the market, rather than loans from a specific public institution, it would likely be impossible to argue that they do not constitute debt instruments within the meaning of the pari passu clauses in currently outstanding bonds. Hence, the possibility of subordinating the existing debt stock seems remote. The two remaining approaches would continue to be feasible, however. In particular, there are at least two ways of engineering the transition without exposing the holders of senior tranches to higher risk than they would face in steady state:

- Create a structure that ensures that losses are shared pro rata between existing bonds and new bonds and are subsequently distributed among the tranches of new bonds in the contractual priority order. With this structure in place, begin issuing all new bonds in several tranches, in their steady state proportions.
- Alternatively, begin by issuing only bonds subordinated to (future) senior bonds, until the share of new (subordinated) bonds in outstanding central government debt is equal to the targeted subordination level. Only then would senior bonds be issued—up to limits specified by statute or in the contracts of junior bonds—replacing old bonds as these mature.

In both cases, the process could be accelerated using debt exchange operations.

Additional complications depend on which variant of the proposal is pursued. In the minimalist version of the proposal, senior tranches would be held by banks directly with no intermediaries to worry about. The version with intermediaries would raise some of the same complications as in the SBBS proposal, but to a lesser extent. The need to regulate intermediaries to ensure that they do not add risk to the system and to ensure the homogeneity of the safe asset carries over to the multitranche issuance proposal. The need to design regulation to ensure market access of the junior SBBS tranche does not carry over, however, since the safe asset would be issued in just one tranche; instead, it is the market access of the national junior bond tranches that must be protected, as described above. Finally, there would be a need to regulate representation of the holders of the safe asset in a debt restructuring, but, as in the E-bond proposal, this is mitigated by the fact that the "marginal" creditors are almost always the junior bond holders. To address extreme defaults in which these would be fully wiped out, the safe bond contract would need to incorporate a mechanism through which the financial intermediaries holding the senior

tranches receive instructions from the ultimate bond holders, as discussed in ESRB (2018) for the SBBS approach.

3. Safety Comparison

By construction, all safe assets discussed in this paper would be equally safe in terms of expected losses, namely, with a five-year expected loss rate of 0.5 percent according to the Brunnermeier et al. (2017) default simulation model (adverse calibration). However, the *distribution* of losses would not be the same. One way of illustrating these differences is to compute the loss rates associated with catastrophic "tail events"—i.e., losses that occur with a specific, low probability. Following ESRB (2018), we focus on a standard measure for such tail losses: the value at risk (VaR) at threshold probability p, defined as the maximum loss occurring with at least probability p. Since small losses are more likely than large losses, the VaR declines as the threshold probability increases. The maximum loss rate is given by the VaR at $p = 0$. In the context of this paper, this represents the case where (1) *all* euro area countries default and (2) the assumed LGD rates are as bad as might reasonably be assumed.

Table 5 shows how the "safe" assets corresponding to each of the proposals discussed in the previous section would fare in this extreme case, based on the maximum LGD assumptions in the Brunnermeier et al. (2017) default model. In that model, LGD assumptions are state contingent; column (1) in the table shows the assumptions corresponding to the worst state (a severe recession). When compared to historically realized creditor losses, these are very conservative assumptions (see Meyer, Reinhart, and Trebesch 2019).

The bottom row of table 5 computes the maximum weighted average loss given default on the cover pool held by the financial intermediary issuing safe assets. For example, in Case C of the SBBS proposal (see table 1) this would be a loss of 61 percent, which is passed on to the SBBS holders; 30 percentage points of this loss would be absorbed by the holders of subordinated tranches, and the rest (31 percent) would be shared among the 70 percent senior tranche holders (the ESBies). This means that in this most cataclysmic of situations, with everyone defaulting and assuming the maximal LGD rates of Brunnermeier et al. (2017), ESBies would lose 31/70 = 44 percent of their value.

The E-bond and multitranche bond issuance proposals would work differently. Because the cover pools consist of senior tranches, most defaults would not even affect the cover pool—as long as the loss given default is smaller than the subordination level. For example, under the one-limit lending rule, 43.3 percent of German debt takes the form of subordinated bonds, whereas the maximum loss given default assumed for Germany is 40 percent. Hence, the worst loss given default that the E-bond issuer could pass

through to the E-bond holders on account of a German default is zero, as there are enough subordinated instruments to absorb the blow. In the case of Slovakia, the subordination level is 52 percent, whereas the maximum loss given default is assumed to be 70 percent. In this case, subordinated debt would absorb most, but not all, of the loss given default, leaving 70 − 52 = 18 percent for the senior debt, which is assumed to make up 48 percent of the total debt face value. The E-bond holder (or the holder of a pool of senior bond tranches) would thus suffer a loss of 18/48 = 37.5 percent on its (indirect) Slovak debt holdings.

The last line in columns (7) and (10) shows the maximal losses given default that the senior debt holder could suffer for the one- and two-limit lending/tranching rules discussed in the previous section. They are computed as the weighted average of columns (7) and (10), using the portfolio weights shown in columns (5) and (8), respectively. The result is a surprisingly small number—much lower than the 44 percent maximal loss given default that might be suffered by the ESBies: just 6.5 and 9.6 percent, respectively. The reason is that the maximal losses given default corresponding to the senior tranches of the large issuers—France, Germany, Belgium, even Italy, on account of its high subordination level—are zero or close to zero, whereas the portfolio weights of countries with higher maximal losses given default are small.

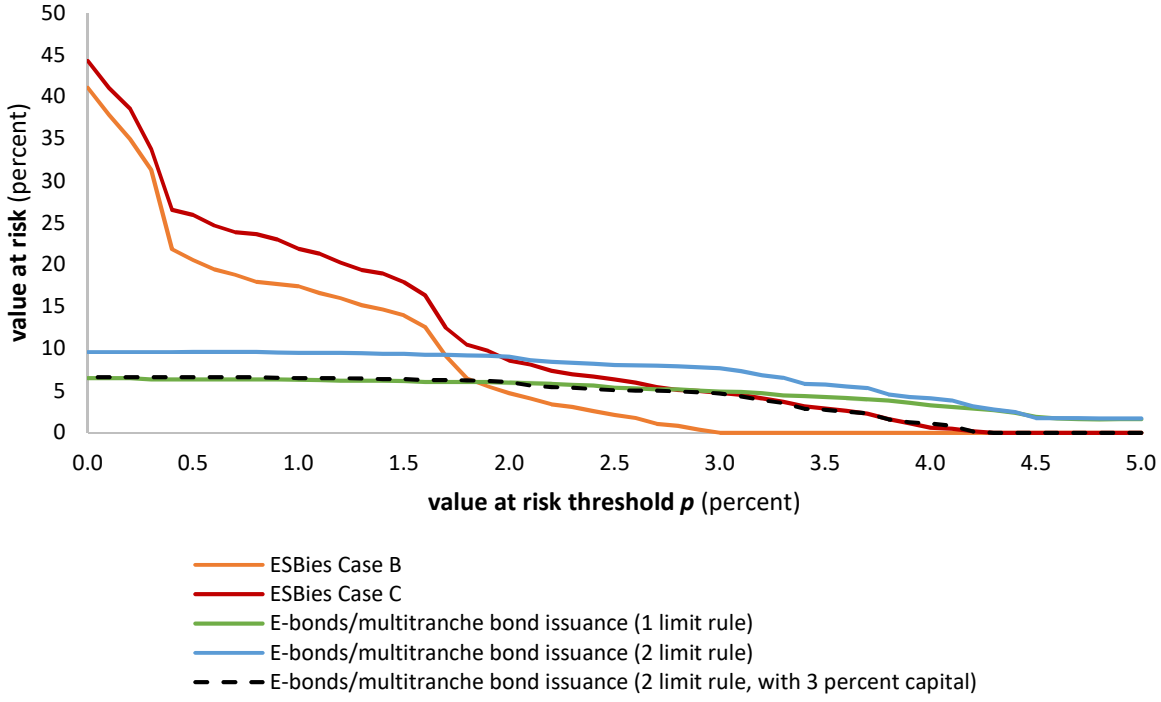
From this perspective, E-bonds or pools of senior national bonds seem much safer than ESBies. However, this is true only for cataclysmic crises that are very unlikely. In less cataclysmic but still severe crises—for example, with high losses given default in two or three countries at the same time—ESBies offer better protection. This is illustrated in figure 1, which shows VaRs for threshold probabilities between zero and 5 percent for two variants of ESBies (corresponding to Cases B and C; the VaR for Case A turns out to be very close to that of Case C), as well as E-bonds/multitranche issuance in the two portfolio variants shown in table 5. For E-bonds, an additional version is shown based on the two-limit lending rule and assuming that the public intermediary would have some capital (3 percent of its liabilities).

The figure implies that ESBies would be fully protected against risks occurring with probability of about 3–4 percent or higher. They are also more protected than E-bonds or pools of senior national bonds against tail risks between about 1.7 and 4 percent. This is because ESBies are fully protected against individual or multiple defaults by euro area member states as long as *aggregate* losses do not exceed the size of the subordinated SBBS tranches. Under the LGD assumptions underlying figure 1, shown in column (1) of table 5, and the portfolio weights corresponding to case C, ESBies would still offer full protection if all other countries with credit ratings worse than Ireland default—including both Italy and Spain—but suffer a loss if additional countries default. Once this cushion of junior and mezzanine bonds

is depleted, however, holders of ESBies bear the full cost of any further defaults. This explains why the VaR curve for ESBies rises much more steeply than for E-bonds below a critical value of *p*.

In contrast, E-bonds and pools of senior national tranches bear losses any time the losses given default of a *single* country exceed the portion of its debt held by subordinated debt holders. However, they continue to offer protection regardless of how many countries default, including full protection for most large borrowers, based on the LGD assumptions and subordination levels shown in table 5. For this reason, as the probability threshold goes to zero, the VaRs of national tranching and pooling and E-bonds converge to much lower levels than the VaR of ESBies.

Figure 1. Value at Risk of alternative safe assets at different probability thresholds



Note: The figure uses portfolio weights from table 5. For the two variants of ESBies shown, the maximum loss (VaR at $p = 0$) is equal to the maximum loss suffered by the SBBS cover pool (see table 5, bottom row), minus the 30 percentage points absorbed by the subordinated tranches, divided by the size of the senior tranche (70 percent). For E-bonds or multitranche bond issuance, the maximum losses incurred by the pool of senior bonds correspond to those shown in the bottom row in table 5. The VaR for E-bonds/multitranche bonds issuance (2-limit rule, with 3 percent capital) is computed by subtracting 3 percentage points from the VaR for E-bonds/multitranche bonds issuance (2-limit rule).

Source: Authors' calculations based on the adverse calibration of the simulation model by Brunnermeier et al. (2017).

To offer even better protection against severe defaults by large countries or combinations of smaller countries, the E-bond intermediary could be capitalized. Figure 1 shows that 3 percent capitalization would offer the same degree of protection as ESBies for moderate tail risks, along with better protection against extreme risks. The blacked dashed line represents a downward shift of the VaR for E-bonds (two-limit case) by 3 percentage points. This results in a VaR that initially follows about the same curve as the VaR for ESBies (Case C) but eventually converges at just 6.6 percent of face value (9.6 percent minus 3 percentage points of capital).

4. Conclusion

This paper evaluates proposals to create a safe asset for the euro area that do not require collective guarantees, nor the creation of a euro area–level fiscal authority which remains politically improbable in the foreseeable future. We compared a proposal by Brunnermeier et al. (2011, 2017) to create multitranche, sovereign bond-backed securities (SBBS)—the most senior of which would be the "safe" asset—to two other designs that have received less attention. In the "E-bonds" proposal, a senior, public financial intermediary would lend to all euro area members up to a limit set as a share GDP—or as a share of GDP and a share of the central government debt stock, whichever is smaller—and issue single-tranche securities backed by this portfolio of loans. Alternatively, euro area sovereigns could agree to issue sovereign bonds in several tranches, with a limit on senior issuance set as a share of GDP (or both as share of GDP and a share of the central government debt stock, whichever is smaller). Banks could be required to hold diversified portfolios of these senior tranches. Alternatively, following the SBBS template, regulated private intermediaries could purchase portfolios of senior tranches and issue a homogeneous, single-tranche security backed by these portfolios.

Our comparison does not produce a clear winner. In principle, all three proposals could be designed to generate roughly the same volume of safe assets: about €2.5 trillion, based on central government debt only (while the legislative resolution passed by the European Parliament (2019) would seem to constrain ESBies to less than €1 trillion, it could be modified to allow larger volumes). Beyond this similarity, the three proposals have different properties that might appeal to some but not to others.

- SBBS/ESBies and safe assets based on senior national bonds issued to the market would avoid redistribution across countries. In contrast, E-bonds would involve some redistribution because all sovereigns borrowing from the public intermediary would be charged the same interest rate. However, because the public intermediary is senior, the sovereign risk it faces—and consequently the extent of expected redistribution—would be fairly low.

- ESBies would be fully protected against a wide range of risks, including multiple deep defaults, except for cataclysmic crises involving simultaneous defaults by most of the largest euro area borrowers.
- E-bonds and multi-tranche bond issuance would provide better protection than ESBies in such worst-case scenarios but would be less effective than ESBies in protecting their holders from deep defaults of individual countries (or a handful of individual countries) in which losses given default exceed the subordination level.
- SBBS/ESBies would have no impact on the cost of borrowing in sovereign debt markets (except possibly through liquidity effects). In contrast, both E-bonds and multi-tranche bond issuance, with a cap on the volume of senior tranches set in terms of GDP, would raise the marginal cost of borrowing from the market. In that sense, E-bonds and multitranche bond issuance as described in this paper would have a disciplining effect on government borrowing—without, however, increasing the overall cost of borrowing for high-debt countries compared to the status quo, since the higher cost of issuing subordinated instruments would be offset by the lower cost of borrowing through senior instruments.

Among the three proposals, only SBBS have so far received extensive public scrutiny, as well as considerable criticism. Based on the analysis in this paper, much of this criticism appears unwarranted. In particular, the claim that ESBies could not withstand correlated defaults is untrue: while they would suffer higher losses than E-bonds or pools of senior national bonds in a crisis in which most euro area countries (including France and/or Germany) default, they would do well in only slightly less extreme crises, in which most lower-rated countries default. Worries that the junior tranche might not find buyers and that SBBS might sap liquidity from national bond markets can be addressed through regulation: by excluding countries that lose market access from the SBBS cover pool, by prohibiting sovereigns from discriminating against SBBS intermediaries, and by placing limits on the volume of sovereign debt that SBBS issuers can buy.

This said, making ESBies work as intended requires a lot of well-designed regulation—more so than the alternative proposals. Furthermore, the legislative resolution recently adopted by the European Parliament is still some way off from what would be needed: on one hand, it appears to excessively constrain the volume of SBBS that could be produced; on the other, it fails to regulate the representation of SBBS holders in the event of a debt restructuring. That said, the competitors have their own issues. The E-bond proposal, for example, is predicated on euro area sovereigns respecting the seniority of the E-bond issuer, even when the holders of (subordinated) bonds are their own citizens.

There are several feasible approaches to creating a euro area safe asset. While none is free of drawbacks, the two lesser known ideas analyzed in this paper—E-bonds and multitranche national bond issuance, with GDP-based caps on senior issues—deserve a more thorough examination than they have received so far.

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Table 1. SBBS: Composition of the cover pools

(in € billion unless otherwise stated)

	Sovereign bonds outstanding				Case A		Case B		Case C	
	In € billion	in % of 2018 GDP	5-year expected losses (%)	ECB capital key (%)	Sovereign bonds purchased	Portfolio weights (%)	Sovereign bonds purchased	Portfolio weights (%)	Sovereign bonds purchased	Portfolio weights (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Germany	1119.5	33.1	0.50	26.4	264.7	28.8	407.9	30.1	919.5	26.1
Netherlands	288.3	37.3	0.69	5.8	48.5	5.3	73.9	5.5	144.2	4.1
Luxembourg	8.3	14.0	0.69	0.3	3.3	0.4	4.1	0.3	4.1	0.1
Austria	251.0	65.0	0.96	2.9	24.2	2.6	36.9	2.7	125.5	3.6
Finland	96.7	41.4	0.96	1.8	15.2	1.6	23.1	1.7	48.3	1.4
France	1700.7	72.4	1.94	20.4	187.2	20.4	315.5	23.3	768.8	21.8
Belgium	356.7	79.2	2.64	3.6	30.2	3.3	45.9	3.4	177.4	5.0
Estonia	0.05	0.2	3.10	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Slovakia	35.2	39.0	5.58	1.1	10.9	1.2	14.5	1.1	17.6	0.5
Ireland	137.4	43.1	6.05	1.7	15.6	1.7	21.4	1.6	68.7	1.9
Latvia	8.0	27.3	6.81	0.4	3.9	0.4	0.0	0.0	4.0	0.1
Lithuania	9.7	21.5	6.80	0.6	4.8	0.5	0.0	0.0	4.8	0.1
Malta	4.9	39.4	7.32	0.1	0.9	0.1	1.3	0.1	2.4	0.1
Slovenia	25.8	56.3	8.17	0.5	4.2	0.5	6.1	0.5	12.9	0.4
Spain	924.1	76.5	6.80	12.0	106.7	11.6	151.5	11.2	471.7	13.4
Italy	1860.3	105.9	7.22	17.0	156.0	17.0	218.2	16.1	647.1	18.4
Portugal	147.9	73.4	11.80	2.4	20.9	2.3	29.7	2.2	74.0	2.1
Cyprus	11.8	56.9	16.07	0.2	2.2	0.2	2.7	0.2	5.9	0.2
Greece	57.3	31.0	35.19	2.5	20.6	2.2	0.0	0.0	28.7	0.8
Total	**7043.7**			**100**	**920.0**	**100**	**1353.0**	**100**	**3525.6**	**100**
Memorandum items:	ESBies volume (€ bn)				644.0		947.1		2467.9	
	ESBies 5-year EL				0.49		0.39		0.55	
	RMSE					0.59		1.05		0.90

ECB = European Central Bank; ESBies = European Safe Bonds; SBBS = sovereign bond-backed securities; EL = expected loss rate; RMSE = root mean square error

Note: Column 1 shows the amounts of long-term central government debt securities outstanding; Column 4 shows the ECB's capital key shares.

Sources: Eurostat, European Central Bank, and authors' calculations using the simulation model in Brunnermeier et al. (2017).

Table 2. E-bond purchase portfolio and expected losses

(in percent unless otherwise stated)

	One-limit rule: lending = 18.7% of GDP						Two-limit rule: lending = min{22.8% of GDP; 52.5% of debt}					
		Purchase volume in % of						Purchase volume in % of				
	Purchase volume in € billion	GDP	Debt	Portfolio	Implicit subordination level	5-year exp. loss rate faced by intermediary	Purchase volume in € billion	GDP	Debt	Portfolio	Implicit subordination level	5-year exp. loss rate faced by intermediary
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Germany	634.4	18.7	56.7	29.3	43.3	0.00	587.7	17.4	52.5	24.6	47.5	0.00
Netherlands	144.9	18.7	50.3	6.7	49.7	0.00	151.4	19.6	52.5	6.3	47.5	0.00
Luxembourg	8.3	14.0	100.0	0.4	0.0	0.69	4.3	7.4	52.5	0.2	47.5	0.00
Austria	72.3	18.7	28.8	3.3	71.2	0.00	87.9	22.8	35.0	3.7	65.0	0.00
Finland	43.8	18.7	45.3	2.0	54.7	0.00	50.7	21.7	52.5	2.1	47.5	0.00
France	440.1	18.7	25.9	20.4	74.1	0.00	534.7	22.8	31.4	22.4	68.6	0.00
Belgium	84.4	18.7	23.7	3.9	76.3	0.00	102.6	22.8	28.8	4.3	71.2	0.00
Estonia	0.05	0.2	100.0	0.0	0.0	3.10	0.0	0.1	52.5	0.0	47.5	1.19
Slovakia	16.9	18.7	48.0	0.8	52.0	1.68	18.5	20.5	52.5	0.8	47.5	2.24
Ireland	59.7	18.7	43.4	2.8	56.6	1.78	72.1	22.7	52.5	3.0	47.5	3.04
Latvia	5.5	18.7	68.7	0.3	31.3	5.08	4.2	14.3	52.5	0.2	47.5	3.36
Lithuania	8.5	18.7	87.3	0.4	12.7	6.22	5.1	11.3	52.5	0.2	47.5	3.35
Malta	2.3	18.7	47.6	0.1	52.4	3.44	2.5	20.7	52.5	0.1	47.5	3.98
Slovenia	8.6	18.7	33.3	0.4	66.7	1.46	10.5	22.8	40.5	0.4	59.5	2.64
Spain	226.4	18.7	24.5	10.5	75.5	0.57	275.0	22.8	29.8	11.5	70.2	1.13
Italy	329.2	18.7	17.7	15.2	82.3	0.00	400.0	22.8	21.5	16.7	78.5	0.17
Portugal	37.8	18.7	25.5	1.7	74.5	1.66	45.9	22.8	31.0	1.9	69.0	2.03
Cyprus	3.9	18.7	32.9	0.2	67.1	3.73	4.7	22.8	40.0	0.2	60.0	6.14
Greece	34.6	18.7	60.4	1.6	39.6	20.80	30.1	16.3	52.5	1.3	47.5	15.56
Total portfolio	**2161.5**					**0.54**	**2388.0**					**0.54**
Memorandum item: RMSE				0.96						0.81		

RMSE = root mean square error

Note: The table shows purchase volumes and 5-year expected loss rates from the perspective of the E-bond issuer buying national debt, arising from two purchase rules. Under the first rule, the issuer buys 18.7% of GDP worth of central government debt. Under the second, the issuer buys either 52.5% of national debt or 22.8% of GDP worth of debt, whichever is smaller. Under the second rule, for example, for Germany, 52.5% of national debt is bought, for Italy, 21.5% of GDP. The were chosen to maximize the size of the portfolio (and hence the volume of E-bonds backed by the portfolio) subject to keeping the portfolio 5-year expected loss at or below 0.5%. In the last row of the table, the total portfolio purchase volume is computed as the sum of the country purchase volumes, while the total portfolio 5-year expected loss of 0.5% is computed as the weighted average of the country 5-year expected losses shown in the final column, using the portfolio purchase shares as weights.

Sources: Eurostat, European Central Bank, and authors' calculations based on simulation model of Brunnermeier et al. (2017).

Table 3. Redistributive effects of the E-bond proposal

(in € billion unless otherwise stated)

	One-limit rule: lending = 18.7% of GDP					Two-limit rule: lending = min{22.8% of GDP; 52.5% of debt}				
	Debt volume held by E-bond inter-mediary	Expected loss rates faced by inter-mediary (%)	Expected losses caused	Expected losses absorbed	Expected transfer (>0 means recipient)	Debt volume held by E-bond inter-mediary	Expected loss rates faced by inter-mediary (%)	Expected losses caused	Expected losses absorbed	Expected transfer (>0 means recipient)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Germany	634.4	0.0	0.00	2.88	−2.88	587.7	0.0	0.00	2.48	−2.48
Netherlands	144.9	0.0	0.00	0.66	−0.66	151.4	0.0	0.00	0.64	−0.64
Luxembourg	8.3	0.3	0.02	0.04	−0.02	4.3	0.0	0.00	0.02	−0.02
Austria	72.3	0.0	0.00	0.33	−0.33	87.9	0.0	0.00	0.37	−0.37
Finland	43.8	0.0	0.00	0.20	−0.20	50.7	0.0	0.00	0.21	−0.21
France	440.1	0.0	0.00	2.00	−2.00	534.7	0.0	0.00	2.25	−2.25
Belgium	84.4	0.0	0.00	0.38	−0.38	102.6	0.0	0.00	0.43	−0.43
Estonia	0.0	1.8	0.00	0.00	0.00	0.0	0.8	0.00	0.00	0.00
Slovakia	16.9	0.7	0.12	0.08	0.05	18.5	0.9	0.17	0.08	0.09
Ireland	59.7	0.9	0.52	0.27	0.25	72.1	1.3	0.95	0.30	0.65
Latvia	5.5	2.6	0.14	0.03	0.12	4.2	1.8	0.08	0.02	0.06
Lithuania	8.5	3.1	0.27	0.04	0.23	5.1	1.8	0.09	0.02	0.07
Malta	2.3	2.0	0.05	0.01	0.04	2.5	2.3	0.06	0.01	0.05
Slovenia	8.6	1.1	0.09	0.04	0.05	10.5	1.8	0.19	0.04	0.14
Spain	226.4	0.5	1.03	1.03	0.00	275.0	0.9	2.50	1.16	1.34
Italy	329.2	0.0	0.00	1.49	−1.49	400.0	0.1	0.56	1.69	−1.12
Portugal	37.8	1.3	0.51	0.17	0.34	45.9	1.6	0.75	0.19	0.56
Cyprus	3.9	3.1	0.12	0.02	0.10	4.7	5.1	0.24	0.02	0.22
Greece	34.6	20.0	6.92	0.16	6.77	30.1	14.9	4.47	0.13	4.35
Total or weighted average	**2161.5**	**0.45**	**9.80**	**9.80**	**7.95**	**2388.0**	**0.42**	**10.07**	**10.07**	**7.53**

Note: Redistributive effects are based on the benchmark calibration of the Brunnermeier et al. (2017) default simulation model. Expected loss rates, expected losses, and expected transfers all refer to a five-year horizon. Columns (2) and (7) show 5-year expected loss rates from the perspective of the E-bond intermediary assuming the subordination levels shown in columns (5) and (11) of table 2, respectively. Note that these expected loss rates are different from the expected loss rates shown in columns (6) and (12) of table 2 because the latter are based on the adverse calibration of the Brunnermeier et al (2017). model.

Columns (3) and (8) multiply the expected loss rates shown in these columns with the debt volumes shown in columns (1) and (6), respectively. Columns (4) and (9) show the losses that each participating country would be expected to cover, assuming that total losses are distributed in proportion to the shares of debt held by the intermediary as shown in columns (1) and (6), respectively. Columns (5) and (10) show the difference between columns (3) and (4) and between (9) and (8), respectively. They represent the expected transfer from or to any given country under either the one-limit rule (column 5) or the two-limit rule (column 10). Positive numbers mean that the country is a net transfer recipient.

Sources: Authors' calculations based on Eurostat data and Brunnermeier et al. (2017) default simulation model.

Table 4. Change in marginal borrowing costs associated with E-bond proposal (based on 2-limit rule)
(in percent)

		Using probabilities of default (p) and loss given default (l) based on Brunnermeier et al. (2017) model				Using loss given default implicit in Brunnermeier et al. (2017) model and April 2019 sovereign spreads to infer probability of default			
	Subordination level (s)	Probability of default (p)	Loss given default (l)	Loss given default of subordinated debt (l_s)	Rise in bond spread ($r_s - r$)	Probability of default (p)	Loss given default (l)	Loss given default of subordinated debt (l_s)	Rise in bond spread ($r_s - r$)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Germany	47.5	0.1	37.0	78.0	0.03	0.1	37.0	78.0	0.03
Netherlands	47.5	0.1	37.0	77.9	0.06	0.5	37.0	77.9	0.22
Luxembourg	47.5	0.1	37.0	77.9	0.06	n.a.	37.0	77.9	n.a.
Austria	65.0	0.2	41.0	63.1	0.05	0.7	41.0	63.1	0.16
Finland	47.5	0.2	41.0	86.4	0.11	0.6	41.0	86.4	0.27
France	68.6	0.4	54.6	79.6	0.10	0.7	54.6	79.6	0.17
Belgium	71.2	0.5	56.3	79.0	0.11	0.8	56.3	79.0	0.19
Estonia	47.5	0.6	60.6	100.0	0.24	n.a.	60.6	100.0	n.a.
Slovakia	47.5	0.7	62.3	100.0	0.25	0.9	62.3	100.0	0.34
Ireland	47.5	0.7	67.2	100.0	0.23	0.8	67.2	100.0	0.26
Latvia	47.5	1.0	65.7	100.0	0.36	0.9	65.7	100.0	0.30
Lithuania	47.5	1.0	65.7	100.0	0.36	n.a.	65.7	100.0	n.a.
Malta	47.5	1.1	68.1	100.0	0.37	n.a.	68.1	100.0	n.a.
Slovenia	59.5	1.4	69.3	100.0	0.43	0.9	69.3	100.0	0.29
Spain	70.2	1.4	69.2	98.6	0.41	1.5	69.2	98.6	0.45
Italy	78.5	1.6	68.8	87.6	0.31	3.6	68.8	87.6	0.71
Portugal	69.0	2.5	68.8	99.8	0.80	1.7	68.8	99.8	0.52
Cyprus	60.0	4.0	64.3	100.0	1.49	2.2	64.3	100.0	0.80
Greece	47.5	9.8	61.7	100.0	4.17	5.1	61.7	100.0	2.05

n.a. = not applicable

Note: The table shows the expected rise in bond spreads as a result of the subordination of bonds by loans from the E-bond issuer, based on the subordination levels implied by the two-limit rule discussed in the text (lending of the E-bond issuer to country i equals either 22.8 percent of GDP or 52.5 of central government debt, whichever is smaller). The expected rise in bond spreads, denoted $r_s - r$ (where r_s refers to the interest rate with subordination and r to the interest rate without subordination) is computed using two different methods. Both assume that interest parity holds—that is, that the yield of subordinated bonds (r_s) exceeds the yield of unsubordinated bonds (r) by the amount needed to compensate risk-neutral bond holders for the higher loss given default of the subordinated bond. Specifically, $r_s - r = (l_s - l)*p/(1 - p)$, where ls is the loss-given-default of the subordinated bond, l is the loss-given-default of the unsubordinated bond, and p is the probability of default.

The two methods differ with respect to the assumed probability of default. In the first (columns 2, 3, 4, and 5) both p (column 2) and l (column 3) are based on the Brunnermeier et al. (2017) default model, while in column 4, l_s = min (100, l/s), where s is the subordination level shown in column (1). The second method (columns 6, 7, 8, and 9) assumes the same l and l_s as in in the first method, but p is inferred from observed yields in April 2019, given l, and assuming interest parity (see appendix B).

Sources: Authors' calculations based on Eurostat, Blomberg and Brunnermeier et al's (2017) default simulation model.

Table 5. Maximal losses given default

(in percent)

	Maximal losses given default (l_m) assumed by Brunner-meier et al. (2017)	SBBS			E-bonds and multitranche bond issuance (one-limit case)			E-bonds and multitranche bond issuance (two-limit case)		
		Portfolio weights								
		Case A	Case B	Case C	Portfolio weights (table 2, column 4)	Subordination level (table 2, column 5)	Maximal losses given default suffered by senior debt	Portfolio weights (table 2, column 10)	Subordination level (table 2, column 11)	Maximal losses given default suffered by senior debt
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Germany	40.0	28.8	30.1	26.1	29.3	43.3	0.0	24.6	47.5	0.0
Netherlands	40.0	5.3	5.5	4.1	6.7	49.7	0.0	6.3	47.5	0.0
Luxembourg	40.0	0.4	0.3	0.1	0.4	0.0	40.0	0.2	47.5	0.0
Austria	45.0	2.6	2.7	3.6	3.3	71.2	0.0	3.7	65.0	0.0
Finland	45.0	1.6	1.7	1.4	2.0	54.7	0.0	2.1	47.5	0.0
France	60.0	20.4	23.3	21.8	20.4	74.1	0.0	22.4	68.6	0.0
Belgium	62.5	3.3	3.4	5.0	3.9	76.3	0.0	4.3	71.2	0.0
Estonia	67.5	0.0	0.0	0.0	0.0	0.0	67.5	0.0	47.5	38.1
Slovakia	70.0	1.2	1.1	0.5	0.8	52.0	37.5	0.8	47.5	42.9
Ireland	75.0	1.7	1.6	1.9	2.8	56.6	42.4	3.0	47.5	52.4
Latvia	75.0	0.4	0.0	0.1	0.3	31.3	63.6	0.2	47.5	52.4
Lithuania	75.0	0.5	0.0	0.1	0.4	12.7	71.4	0.2	47.5	52.4
Malta	78.0	0.1	0.1	0.1	0.1	52.4	53.7	0.1	47.5	58.1
Slovenia	80.0	0.5	0.5	0.4	0.4	66.7	39.9	0.4	59.5	50.6
Spain	80.0	11.6	11.2	13.4	10.5	75.5	18.4	11.5	70.2	32.8
Italy	80.0	17.0	16.1	18.4	15.2	82.3	0.0	16.7	78.5	7.0
Portugal	85.0	2.3	2.2	2.1	1.7	74.5	41.3	1.9	69.0	51.6
Cyprus	87.5	0.2	0.2	0.2	0.2	67.1	62.0	0.2	60.0	68.7
Greece	95.0	2.2	0.0	0.8	1.6	39.6	91.7	1.3	47.5	90.5
Maximum aggregate loss given default		60.3	58.8	61.0			6.5			9.6

Note: Column 1 shows the maximal loss-given-default rate (l_m) assumed in the Brunnermeier et al. (2017) simulation model. Columns 2, 3, 4, 5, and 8 show the portfolio weights corresponding to Cases A, B, and C in the SBBS proposal, the one-limit rule in the E-bond/multitranche issuance proposals, and the two-limit rule in the E-bond/multitranche issuance proposals, respectively. Columns 6 and 9 show the subordination levels s implied by the one-limit and two-limit rule, respectively. Columns 7 and 10 show the maximal loss given default from the perspective of the E-bond issuer (or equivalently, the holder of a diversified pool of senior bond tranches), taking into account the subordination levels implied by the one- and two-limit rules, respectively. The entries in columns 6 and 9 are computed as $\max\{0, (s - l_m)/(100 - s)*100\}$. In column 7, s equals the subordination level shown in columns 6, while in column 10, s equals the subordination level shown in column 9. The maximum aggregate losses given default shown in the last line are computed as follows: 60.3 (column 2) is the weighted average of l_m shown in column 1, using the portfolio weights shown in column 2; 58.8 (column 3) and 61.0 (column 4) are computed in the same way, using the portfolio weights shown in columns 3 and 4, respectively; 6.5 (column 7) is the weighted average of the maximal losses given default shown in column 7, using the portfolio weights shown in column 5; and 9.6 (column 10) is the weighted average of the maximal losses given default shown in column 10, using the portfolio weights shown in column 8.

Sources: Brunnermeier et al. (2017), ESRB (2018), and Leandro and Zettelmeyer (2018a).

Appendix A

Table A1. Change in borrowing costs associated with E-bond proposal (based on one-limit rule)

(in percent)

		Using probabilities of default (p) and loss given default (l) based on Brunnermeier et al. (2017) model				Using loss given default implicit in Brunnermeier et al. (2017) model and April 2019 sovereign spreads to infer probability of default			
	Subordination level (s)	Probability of default (p)	Loss given default (l)	Loss given default of subordinated debt (l_s)	Rise in bond spread ($r - r_s$)	Probability of default (p)	Loss given default (l)	Loss given default of subordinated debt (l_s)	Rise in bond spread ($r - r_s$)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Germany	43.3	0.1	37.0	85.5	0.04	0.1	37.0	85.5	0.03
Netherlands	49.7	0.1	37.0	74.4	0.05	0.5	37.0	74.4	0.20
Luxembourg	0.0	0.1	37.0	n.a.	n.a.	n.a.	37.0	n.a.	n.a.
Austria	71.2	0.2	41.0	57.6	0.04	0.7	41.0	57.6	0.12
Finland	54.7	0.2	41.0	74.9	0.08	0.6	41.0	74.9	0.20
France	74.1	0.4	54.6	73.6	0.08	0.7	54.6	73.6	0.13
Belgium	76.3	0.5	56.3	73.7	0.09	0.8	56.3	73.7	0.14
Estonia	0.0	0.6	60.6	n.a.	n.a.	n.a.	60.6	n.a.	n.a.
Slovakia	52.0	0.7	62.3	100.0	0.25	0.9	62.3	100.0	0.34
Ireland	56.6	0.7	67.2	100.0	0.23	0.8	67.2	100.0	0.26
Latvia	31.3	1.0	65.7	100.0	0.36	0.9	65.7	100.0	0.30
Lithuania	12.7	1.0	65.7	100.0	0.36	n.a.	65.7	100.0	n.a.
Malta	52.4	1.1	68.1	100.0	0.37	n.a.	68.1	100.0	n.a.
Slovenia	66.7	1.4	69.3	100.0	0.43	0.9	69.3	100.0	0.29
Spain	75.5	1.4	69.2	91.7	0.32	1.5	69.2	91.7	0.35
Italy	82.3	1.6	68.8	83.6	0.24	3.6	68.8	83.6	0.56
Portugal	74.5	2.5	68.8	92.4	0.61	1.7	68.8	92.4	0.40
Cyprus	67.1	4.0	64.3	95.9	1.32	2.2	64.3	95.9	0.71
Greece	39.6	9.8	61.7	100.0	4.17	5.1	61.7	100.0	2.05

n.a. = not applicable

Note: The table shows the expected rise in bond spreads as a result of the subordination of bonds by loans from the E-bond issuer, based on the subordination levels implied by the one-limit rule discussed in the text (lending of the E-bond issuer to country i equals 18.7 percent of GDP). The expected rise in bond spreads, denoted $r_s - r$ (where r_s refers to the interest rate with subordination and r to the interest rate without subordination), is computed using two different methods. Both assume that interest parity holds—that is, that the yield of subordinated bonds (r_s) exceeds the yield of unsubordinated bonds (r) by the amount needed to compensate risk-neutral bond holders for the higher loss given default of the subordinated bond. Specifically, $r_s - r = (l_s - l)*p/(1 - p)$, where l_s is the loss given default of the subordinated bond, l is the loss given default of the unsubordinated bond, and p is the probability of default. The two methods differ with respect to the assumed probability of default. In the first (columns 2, 3, 4, and 5) both p (column 2) and l (column 3) are based on the Brunnermeier et al. (2017) default model, while in column 4, $l_s = \min(100, l/s)$, where s is the subordination level shown in column (1). The second method (columns 6, 7, 8, and 9) assumes the same l and l_s as in in the first method, but p is inferred from observed yields in April 2019, given l, and assuming interest parity (see appendix B).

Sources: Authors' calculations based on Eurostat data and Brunnermeier et al. (2017) default simulation model.

Appendix B. Impact of senior lending on marginal cost of debt issued to the market

Let p denote the probability of default, l the loss given default, and s the subordination level (the share of subordinated bonds in total sovereign debt). The loss given default for the holder of a subordinated instrument is given by

$$l_s = \min\left\{1, \frac{l}{s}\right\}$$

We assume that the yield of bonds adjusts to equalize the expected return across bonds (i.e., interest parity holds; this assumes risk neutral investors). In that case

$$p(1-l) + (1-p)(1+r) = p(1-l_s) + (1-p)(1+r_s)$$

where r is the yield of unsubordinated bonds and r_s the yield of a subordinated bond with subordination level s. Hence:

$$r_s - r = \frac{p}{1-p} * (l_s - l)$$

This equation is used in both sets of estimates in table 4. The difference consists in how p is determined. On the left side of the table, this is based on the Brunnermeier et al. (2017) default model, which was calibrated using end-2015 market data. On the right side of the table, it is based on market yields observed in April 2019.

Model-based approach (columns 2–5 of table 4)

$p = \frac{EL_{1yr}}{l}$ and $l = \frac{EL_{5yr}}{p_{5yr}}$,

where $EL_{1yr} \equiv (\sqrt[5]{(1 + EL_{5yr})} - 1) * 100$, and

- EL_{5yr} is the 5-year expected loss rate from the Brunnermeier et al. (2017) simulation.
- p_{5yr} is the 5-year probability (actually, frequency) of default after running the simulation.

Approach based on April 2019 data (columns 6–9 of table 4)

We continue using l as defined above, i.e., the loss given default rate implicit in the Brunnermeier et al. (2017) simulations. Using this l, p is inferred from April 2019 yields, assuming interest parity, as follows. Let r^* be the (unobservable) yield of a risk-free bond. Interest parity implies

$p(1-l) + (1-p)(1+r) = (1+r^*)$, which can be solved for $p = \frac{r-r^*}{r+l}$.

For r, we use the market yield on 19 April 2019. For r^*, we use $r^* = r_{2019}^{DE} - (1 - \sqrt[5]{(1-0.0013)})$, where 0.0013 is the 5-year expected loss rate for Germany according to Brunnermeier et al. (2017) and r_{2019}^{DE} is the 10-year yield on German bonds in April 2019.