Web appendix to:

ESBies: Safety in the tranches*

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Abstract

This web appendix accompanies the paper "ESBies: Safety in the tranches", in which we advocate the creation of a new union-wide safe asset without joint liability. The purpose of this web appendix is twofold. First, we present variations on the numerical simulations reported in Section 4 of that paper. These variations serve as robustness checks with respect to the paper's conclusions regarding securities' risk characteristics. Second, we set out the mathematics underpinning the model described in Section 5 of the main paper.

*This draft: February 6, 2017. This web appendix accompanies the paper "ESBies: Safety in the Tranches", published in *Economic Policy*. The views expressed herein are those of the authors and do not necessarily represent the views of the institutions to which they are affiliated.

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1 Numerical simulations

In the paper "ESBies: Safety in the tranches", we conduct numerical simulations to examine the risk characteristics of European Safe Bonds (ESBies) under benchmark and adverse calibrations of the model.

The key result from these simulations is that ESBies with a subordination level of 30% have an expected loss rate similar to that of German bunds. At the same time, they would increase the supply of safe assets relative to the *status quo*. The corresponding junior securities would be attractive investments, thanks to their embedded leverage and expected loss rates similar to those of vulnerable euro area sovereign bonds.

In this web appendix, we test the robustness of these results to different simulation design choices. In particular, we evaluate the following variations on the simulations conducted in the main paper:

Higher LGDs (Subsection 1.1): In this variation, we shift the distribution of loss-given-default rates to the right by 15%. Conditional on a nation-state's default, average losses imposed on bond holders are higher than under the benchmark and adverse calibrations envisaged in the main paper. We retain the relative ranking of average LGDs across nation-states.

Higher PDs (Subsection 1.2): We shift the distribution of default rates to the right by 15%. All nation-states are likelier to default than under the benchmark calibration envisaged in the main paper. Again, we retain nation-states' relative ranking.

More frequent severe recessions (Subsection 1.3): Severe recessions occur 10%, rather than 5%, of the time, while mild recessions occur 20%, rather than 25%, of the time. This calibration is much more pessimistic, since most defaults occur during severe recessions when default probabilities are elevated.

Very adverse (Subsection 1.4): The adverse calibration of the simulation model reported in the main paper is subject to more severe contagion assumptions. When Germany, France, Italy or Spain defaults, others are even more likely to default.

In this web appendix, results from each variant simulation are reported and discussed in the corresponding sections. In general, ESBies continue to perform well in the more severe calibrations simulated in this web appendix. In all calibrations, the expected loss rate of ESBies with 30% subordination is similar to that of the *status quo* German bund. And in all calibrations, ESBies are able to increase the volume of safe assets relative to the *status quo*, *national tranching* or *pure pooling*. In most cases, this is achieved with our base-case of 30% subordination; only in the "very adverse" calibration is it necessary to increase ESBies' subordination to 40% in order to ensure their safety.

1.1 Higher loss-given-default rates

In this variant, the benchmark calibration in the main paper is repeated with loss-given-default rates that are 15% higher. The new LGDs in each of the three states of the world—i.e. severe recession, mild recession and macroeconomic expansion—are reported in Table 1.

In this calibration, five-year expected loss rates mechanically increase across the board, as we show in Table 2. Nevertheless, the three highest rated nation-states—namely Germany, the Netherlands and Luxembourg—remain comfortably below the 0.5% safety threshold, with five-year expected loss rates of 0.15%, 0.31% and 0.31% respectively. ESBies with a subordination level of 30% have a five-year expected loss rate of 0.18%, which remains similar to that of Germany's.

The expected loss rate of the junior tranche increases from 9.10% in the benchmark calibration to 10.24% in the "higher LGDs" variant. The junior tranche can still be subtranched to create an investment grade mezzanine tranche. With 30% subordination, this can be achieved by splitting the junior tranche in half: the 15% mezzanine tranche has an expected loss rate of 3.42%, which maps to an investment grade credit rating of A- (i.e. ranked 7 on a 1-22 rating scale); and the equity tranche has an expected loss rate of 17.07%, which is speculative grade.

1.2 Higher default rates

Here, default rates are 15% higher than in the benchmark calibration in the main paper. The new PDs are reported in Table 3.

Five-year expected loss rates increase across the board (Table 4), albeit by slightly less than in Subsection 1.1. ESBies with a 30% subordination level have an expected loss rate of 0.14%, which is slightly lower than that of untranched German bunds (0.15%).

Likewise, the risk characteristics of the junior tranche are similar compared with Subsection 1.1: the expected loss rate at 30% subordination is 10.35%. With 50/50 subtranching, the 15%-thick mezzanine tranche easily achieves investment grade, with an expected loss rate of 3.39%, while the corresponding equity tranche would have an expected loss rate of 17.31%.

1.3 More frequent severe recessions

We conduct a sensitivity analysis of the results with respect to the *ex ante* recession probabilities. In particular, we now assume that severe recessions occur 10%, rather than 5%, of the time, while mild recessions occur 20%, rather than 25%, of the time. This calibration is considerably more pessimistic, since defaults are more likely to occur during severe recessions.

In this calibration, *status quo* German bunds' expected loss rate increases from 0.13% (in the benchmark calibration) to 0.24%. With 30% subordination, ESBies' expected loss rate increases from 0.09% to 0.19%. They therefore remain slightly safer than German bunds.

The junior tranche is slightly riskier than in Subsection 1.1 and Subsection 1.2, with an expected loss rate of 12.12%. Nevertheless, this junior tranche can be sub-tranched to create an investment grade 15%-thick mezzanine tranche (with an expected loss rate of 5.47%) and a high-yielding equity tranche (18.78%).

1.4 Very adverse calibration

Here, we perform a sensitivity analysis of the contagion assumptions that governs the adverse calibration of the simulation reported in the main paper. In particular, we make four contagion assumptions, imposed sequentially in the following order:

1. Whenever there is a German default, others default with 75% probability. (In the main paper, this probability is set at 50%.)

2. Whenever there is a French default, other nation-states default with 75% probability, except the five highest rated nation-states, which default with 25% probability. (In the main paper, these probabilities are 40% and 10% respectively.)

3. Whenever there is an Italian default, the five highest rated nation-states default with 10% probability; the next three nation-states (France, Belgium and Estonia) default with 25% probability; and the other nation-states default with 75% probability—unless any of these nation-states had defaulted at step 1 or 2. (In the main paper, these probabilities are 5%, 10% and 40% respectively.)

4. Whenever there is a Spanish default, other nation-states' default probabilities are the same as under an Italian default—unless any of these nation-states had already defaulted.

These enhancements substantially increase the correlation of defaults across nation-states relative to those in the adverse calibration of the simulation. The first principal component of defaults now explains 57% of covariation in default rates, compared with 42% in the adverse calibration and 29% in the benchmark calibration, and the first three principal components account for 74% of the covariation compared to 64% in the adverse calibration and 57% in the benchmark calibration. Table 6 shows the conditional default probabilities, which have the feature that euro area nation-states are very sensitive to the default of Germany, France, Italy or Spain.

Five-year expected loss rates for *status quo* sovereign bonds are much higher than in the benchmark calibration. In fact, none is safe: *status quo* German bunds have an expected loss rate of 0.96%. They can only be made safe through tranching: with uniform *national tranching* at 30%, German, Dutch and Luxembourgish bonds' expected loss rates are below the 0.5% safety threshold.

With 30% subordination, ESBies are not safe: their expected loss rate stands at 0.98%. Nevertheless, loss rates decline quickly as the subordination level is increased, and at 40% ESBies are safe, with an expected loss rate of 0.39%.

2 Mathematical model

2.1 No Pooling or Tranching

We start with the special case in which banks hold only domestic bonds ($\beta = 0$). This case illustrates our model's basic mechanics without the complexities of pooling and tranching. When banks hold only domestic bonds, the relevant sunspot is the one observed domestically.

We make three parametric assumptions, which we carry over to the cases of pooling and tranching. First, the government's primary surplus before bail-out costs remains positive:

$$\underline{S} - \tau\psi L_0 \geq 0. \tag{2.1}$$

Second, banks' aggregate equity is sufficiently small that the diabolic loop occurs at least if exposure is maximal, such that domestic banks hold all outstanding domestic sovereign bonds (i.e. $\alpha = 1$):

$$E_0 < \pi\tau\psi L_0. \tag{2.2}$$

Third, if the surplus is high, the government can still fully repay its debt even after a bail-out at $t = 2$ for any α (even for $\alpha = 1$):[1]

$$\overline{S} - \underline{S} \geq \tau\psi L_0 - E_0. \tag{2.3}$$

If the sunspot is observed at $t = 1$ and a bail-out occurs at $t = 2$, the government surplus at $t = 3$ is $S - \tau\psi L_0 + \alpha\,(B_1 - \underline{S}) + E_0 =: S \ - \ C$, where C is the implied (endogenous) bail-out cost. Assumption 2.3 ensures that when $S = \overline{S}$ the debt is fully repaid. When $S = \underline{S}$, only $\underline{S} - C$ is repaid. Hence, the price of domestic bonds at $t = 1$ if the sunspot is observed at $t = 1$ and a bail-out is expected to occur at $t = 2$ is $B_1 = \underline{S} - \pi C$, so $\pi C \equiv \Delta_1$ is the price discount relative to the face value $\underline{S}$. Recalling the definition of the bail-out cost C and using $B_1 = \underline{S} - \Delta_1$, we find that the discount Δ_1 is

$$\Delta_1 = \pi\left[\tau\psi L_0 - \alpha(B_1 - \underline{S}) - E_0\right] \tag{2.4}$$

$$= \frac{\pi(\tau\psi L_0 - E_0)}{1 - \alpha\pi}.$$

Hence, banks are left with negative equity if

$$\alpha(B_1 - \underline{S}) + E_0 < 0 \tag{2.5}$$

[1] This assumption is only used to simplify calculations, but can be relaxed without changing the conclusions.

$$\Leftrightarrow E_0 < \alpha\pi\tau\psi L_0.$$

When banks are left with negative equity, the government bails them out if the capital shortfall is smaller than the cost $\tau\psi L_0$ of not bailing them out, i.e.,

$$\alpha(B_1 - \underline{S}) + E_0 + \tau\psi L_0 > 0 \tag{2.6}$$

$$\Leftrightarrow E_0 > (2\alpha\pi - 1)\,\tau\psi L_0.$$

If banks' equity is below the threshold in (2.5), and the bail-out condition (2.6) holds, then the domestic sunspot leads to the domestic diabolic loop equilibrium. Equation (2.5) can hold for some parameter values because of (2.2). Moreover, (2.5) and (2.6) can hold simultaneously for a subset of these values because $\alpha\pi < 1$. Conversely, if banks' equity is above the threshold in (2.5), then the domestic sunspot does not lead to the domestic diabolic loop equilibrium.

2.2 Pooling

When a sunspot is observed in one country it may be the case that only that country must recapitalize its banks. We denote by Δ_{11} the value of Δ_1 for the recapitalizing country: this is the difference between the face value $\underline{S}$ of that country's bond and the bond's price B_1 in period 1. Alternatively, it may be the case that both countries must recapitalize their banks. We denote by Δ_{12} the value of Δ_1 when recapitalization must take place in both countries (regardless of whether this is the outcome of the sunspot being observed in one or both countries): this is the difference between the face value $\underline{S}$ of the bond of either country and the bond price B_1. To compute banks' equity at $t = 1$, we note that their portfolio of $\alpha\underline{S}$ face value of the domestic bond and $\beta\underline{S}$ face value of the pooled security is equivalent to $\left(\alpha + \frac{\beta}{2}\right)\underline{S}$ face value of the domestic bond and $\frac{\beta}{2}\underline{S}$ face value of the foreign bond.

When only one country recapitalizes its banks, the cost for that country is

$$C_1 = \tau\psi L_0 - \left(\alpha + \frac{\beta}{2}\right)(B_1 - \underline{S}) - E_0 \tag{2.7}$$

$$= \tau\psi L_0 + \left(\alpha + \frac{\beta}{2}\right)\Delta_{11} - E_0.$$

Combining (2.7) with $\Delta_{11} = \pi C_1$, we find

$$C_1 = \tau\psi L_0 + \left(\alpha + \frac{\beta}{2}\right)\pi C_1 - E_0 \tag{2.8}$$

$$= \frac{\tau\psi L_0 - E_0}{1 - \left(\alpha + \frac{\beta}{2}\right)\pi}.$$

Hence, banks in the recapitalizing country are left with negative equity if

$$-\left(\alpha + \frac{\beta}{2}\right)\Delta_{11} + E_0 < 0 \tag{2.9}$$

$$\Leftrightarrow E_0 < \left(\alpha + \frac{\beta}{2}\right)\pi\tau\psi L_0.$$

On the other hand, banks in the non-recapitalizing country are left with non-negative equity if

$$-\frac{\beta}{2}\Delta_{11} + E_0 \geq 0 \tag{2.10}$$

$$\Leftrightarrow E_0 \geq \frac{\frac{\beta}{2}}{1 - \alpha\pi}\pi\tau\psi L_0.$$

When both countries recapitalize their banks, the cost per country is

$$C_2 = \tau\psi L_0 - \left(\alpha + \frac{\beta}{2}\right)(B_1 - \underline{S}) - \frac{\beta}{2}(B_1 - \underline{S}) - E_0 \tag{2.11}$$

$$= \tau\psi L_0 + (\alpha + \beta)\,\Delta_{12} - E_0.$$

Combining (2.11) with $\Delta_{12} = \pi C_2$, we find

$$C_2 = \tau\psi L_0 + (\alpha + \beta)\,\pi C_2 - E_0 \tag{2.12}$$

$$= \frac{\tau\psi L_0 - E_0}{1 - (\alpha + \beta)\pi}.$$

Hence, banks in either country are left with negative equity if

$$-\alpha\Delta_{12} + E_0 < 0 \tag{2.13}$$

$$\Leftrightarrow E_0 < (\alpha + \beta)\pi\tau\psi L_0.$$

Based on the above analysis, we can divide the parameter space into four regions:

- $E_0 \geq (\alpha + \beta)\pi\tau\psi L_0$. Equity is large enough that the sunspot, whether observed in one or both countries, does not lead to the diabolic loop equilibrium.
- $(\alpha + \beta)\pi\tau\psi L_0 > E_0 \geq \left(\alpha + \frac{\beta}{2}\right)\pi\tau\psi L_0$. When the sunspot is observed in both countries, it leads to the diabolic loop equilibrium. When it is observed in one country only, and the bond prices in the other country do not move, then the diabolic loop equilibrium does not arise even in the country observing the sunspot. This is the *diversification region*.

- $\left(\alpha + \frac{\beta}{2}\right)\pi\tau\psi L_0 > E_0 \geq \frac{\frac{\beta}{2}}{1-\alpha\pi}\pi\tau\psi L_0$. When the sunspot is observed in both countries, it leads to the diabolic loop equilibrium. When it is observed in one country only, it leads to the diabolic loop equilibrium only in that country.

- $\frac{\frac{\beta}{2}}{1-\alpha\pi}\pi\tau\psi L_0 > E_0$. When the sunspot is observed in both countries, it leads to the diabolic loop equilibrium. When it is observed in one country only, it leads to the diabolic loop equilibrium in both countries. This is the *contagion region*.

We can fix $\gamma := \alpha + \beta$, and plot the four regions in the (E_0, β) space. This is done in ??.

2.3 Pooling and Tranching

As in the case of pooling and no tranching, we distinguish cases depending on whether one or both countries recapitalize their banks. The analysis is more complicated than in the case of pooling and no tranching because we must also distinguish cases depending on whether or not the senior tranche incurs losses. We denote by $B_1^{\mathcal{E}}$ the period 1 price of an ESBies security produced by tranching face value $\underline{S}$ of the pooled security. We also denote by $\Delta_{11}^{\mathcal{E}}$ the difference between the face value $f\underline{S}$ of that ESBies security and the price $B_1^{\mathcal{E}}$ when only one country recapitalizes, and by $\Delta_{12}^{\mathcal{E}}$ the same difference when both countries recapitalize.

2.3.1 Only one country recapitalizes

When only one country recapitalizes its banks, the cost for that country is

$$C_1 = \tau\psi L_0 - \alpha(B_1 - \underline{S}) - \frac{\beta}{f}(B_1^{\mathcal{E}} - f\underline{S}) - E_0 \tag{2.14}$$

$$= \tau\psi L_0 + \alpha\Delta_{11} + \frac{\beta}{f}\Delta_{11}^{\mathcal{E}} - E_0.$$

To compute the equilibrium, we must distinguish two cases.

Case a: The senior tranche incurs no losses. Combining (2.14) with $\Delta_{11} = \pi C_1$ and $\Delta_{11}^{\mathcal{E}} = 0$, we find

$$C_1 = \tau\psi L_0 + \alpha\pi C_1 - E_0 \tag{2.15}$$

$$= \frac{\tau\psi L_0 - E_0}{1 - \alpha\pi}.$$

Banks in the recapitalizing country are left with negative equity if

$$-\alpha\Delta_{11} + E_0 < 0 \tag{2.16}$$

$$\Leftrightarrow E_0 < \alpha\pi\tau\psi L_0.$$

The senior tranche incurs no losses if

$$\underline{S} - \frac{C_1}{2} \geq \underline{S}f \tag{2.17}$$

$$\Leftrightarrow \underline{S}(1-f) \geq \frac{\tau\psi L_0 - E_0}{2(1-\alpha\pi)}.$$

Case b: The senior tranche incurs losses in the state in which the recapitalizing country has primary surplus $\underline{S}$.[2] Combining (2.14) with $\Delta_{11} = \pi C_2$ and $\Delta_{11}^{\mathcal{E}} = \pi\left[\frac{C_2}{2} - \underline{S}(1-f)\right]$, we find

$$C_2 = \tau\psi L_0 + \alpha\pi C_2 + \frac{\beta}{f}\pi\left[\frac{C_2}{2} - \underline{S}(1-f)\right] - E_0 \tag{2.18}$$

$$= \frac{\tau\psi L_0 - E_0 - \frac{\beta}{f}\pi\underline{S}(1-f)}{1 - \left(\alpha + \frac{\beta}{2f}\right)\pi}.$$

Banks in the recapitalizing country are left with negative equity if

$$-\alpha\Delta_{11} - \frac{\beta}{f}\Delta_{11}^{\mathcal{E}} + E_0 < 0 \tag{2.19}$$

$$\Leftrightarrow -\alpha\pi C_2 - \frac{\beta}{f}\pi\left[\frac{C_2}{2} - \underline{S}(1-f)\right] + E_0 < 0$$

$$\Leftrightarrow E_0 < \left(\alpha + \frac{\beta}{2f}\right)\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f).$$

Banks in the non-recapitalizing country are left with non-negative equity if

$$-\frac{\beta}{f}\Delta_{11}^{\mathcal{E}} + E_0 \geq 0 \tag{2.20}$$

$$\Leftrightarrow E_0 \geq \frac{\frac{\beta}{2f}}{1-\alpha\pi}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f).$$ [3]

The senior tranche incurs losses in the state in which the recapitalizing country has primary surplus $\underline{S}$ if

$$\underline{S} - \frac{C_2}{2} < \underline{S}f \tag{2.21}$$

[2] Note that we do not need to distinguish cases according to the primary surplus of the non-recapitalizing country because that country always repays $\underline{S}$ on its bonds.

[3] Note that we do not need to check this condition in Case a because banks in the non-recapitalizing country can be affected only through their exposure in the senior tranche, and the senior tranche incurs no losses.

$$\Leftrightarrow \underline{S}(1-f) < \frac{\tau\psi L_0 - E_0}{2(1-\alpha\pi)}.$$

2.3.2 Both countries recapitalize

When both countries recapitalize their banks, the cost per country is

$$C_2 = \tau\psi L_0 - \alpha(B_1 - \underline{S}) - \frac{\beta}{f}(B_1^{\mathcal{E}} - f\underline{S}) - E_0 \tag{2.22}$$

$$= \tau\psi L_0 + \alpha\Delta_{12} + \frac{\beta}{f}\Delta_{12}^{\mathcal{E}} - E_0.$$

To compute the equilibrium, we must distinguish three cases.

Case a: The senior tranche incurs no losses. Combining (2.22) with $\Delta_{12} = \pi C_2$ and $\Delta_{12}^{\mathcal{E}} = 0$, we find

$$C_2 = \tau\psi L_0 + \alpha\pi C_2 - E_0 \tag{2.23}$$

$$= \frac{\tau\psi L_0 - E_0}{1-\alpha\pi}.$$

Banks in either country are left with negative equity if

$$-\alpha\Delta_{12} + E_0 < 0 \tag{2.24}$$

$$\Leftrightarrow E_0 < \alpha\pi\tau\psi L_0.$$

The senior tranche incurs no losses if

$$\underline{S} - C_2 \geq \underline{S}f \tag{2.25}$$

$$\Leftrightarrow \underline{S}(1-f) \geq \frac{\tau\psi L_0 - E_0}{1-\alpha\pi}.$$

Case b: The senior tranche incurs losses only in the state in which both countries have primary surplus $\underline{S}$. Combining (2.22) with $\Delta_{12} = \pi C_2$ and $\Delta_{12}^{\mathcal{E}} = \pi^2\left[C_2 - \underline{S}(1-f)\right]$, we find

$$C_2 = \tau\psi L_0 + \alpha\pi C_2 + \frac{\beta}{f}\pi^2\left[C_2 - \underline{S}(1-f)\right] - E_0 \tag{2.26}$$

$$= \frac{\tau\psi L_0 - E_0 - \frac{\beta}{f}\pi^2\underline{S}(1-f)}{1-\alpha\pi - \frac{\beta}{f}\pi^2}.$$

Banks in either country are left with negative equity if

$$-\alpha\Delta_{12} - \frac{\beta}{f}\pi^2\Delta_{12}^{\mathcal{E}} + E_0 < 0 \tag{2.27}$$

$$\Leftrightarrow -\alpha\pi C_2 - \frac{\beta}{f}\pi^2 \left[C_2 - \underline{S}(1-f)\right] + E_0 < 0$$

$$\Leftrightarrow E_0 < (\alpha\pi + \frac{\beta}{f}\pi^2)\tau\psi L_0 - \frac{\beta}{f}\pi^2\underline{S}(1-f).$$

The senior tranche incurs losses in the state in which both countries have primary surplus $\underline{S}$ if

$$\underline{S} - C_2 < \underline{S}f \tag{2.28}$$

$$\Leftrightarrow \underline{S}(1-f) < \frac{\tau\psi L_0 - E_0}{1-\alpha\pi}.$$

It incurs no losses in the state in which only one country has primary surplus $\underline{S}$ if

$$\underline{S} - \frac{C_2}{2} \geq \underline{S}f \tag{2.29}$$

$$\Leftrightarrow \underline{S}(1-f) \geq \frac{\tau\psi L_0 - E_0}{2 - 2\alpha\pi - \frac{\beta}{f}\pi^2}.$$

Case c: The senior tranche incurs losses also in the states where only one country has primary surplus $\underline{S}$. Combining (2.22) with $\Delta_{12} = \pi C_2$ and

$$\Delta_{12}^{\mathcal{E}} = \pi^2\left[C_2 - \underline{S}(1-f)\right] + 2\pi(1-\pi)\left[\frac{C_2}{2} - \underline{S}(1-f)\right],$$

we find

$$C_2 = \tau\psi L_0 + \alpha\pi C_2 + \frac{\beta}{f}\left[\pi C_2 - \pi(2-\pi)\underline{S}(1-f)\right] - E_0 \tag{2.30}$$

$$= \frac{\tau\psi L_0 - E_0 - \frac{\beta}{f}\pi(2-\pi)\underline{S}(1-f)}{1-(\alpha+\frac{\beta}{f})\pi}.$$

Banks in either country are left with negative equity if

$$-\alpha\Delta_{12} - \frac{\beta}{f}\Delta_{12}^{\mathcal{E}} + E_0 < 0 \tag{2.31}$$

$$\Leftrightarrow E_0 < (\alpha + \frac{\beta}{f})\pi\tau\psi L_0 - \frac{\beta}{f}\pi(2-\pi)\underline{S}(1-f).$$

The senior tranche incurs losses in the state in which only one country has primary surplus $\underline{S}$ if

$$\underline{S} - \frac{C_2}{2} < \underline{S}f \tag{2.32}$$

$$\Leftrightarrow \underline{S}(1-f) < \frac{\tau\psi L_0 - E_0}{2 - 2\alpha\pi - \frac{\beta}{f}\pi^2}.$$

2.3.3 Parameter regions

Based on the above analysis, we can divide the parameter space into regions, in a way analogous to that in Subsection 2.2. We distinguish cases according to the value of $\underline{S}(1-f)$.

Case 1 (low subordination): $\frac{\tau\psi L_0}{2} > \underline{S}(1-f)$. There are four regions, as follows:

- No diabolic loop: $E_0 \geq (\alpha + \frac{\beta}{f})\pi\tau\psi L_0 - \frac{\beta}{f}\pi(2-\pi)\underline{S}(1-f)$.
- Diversification region: $(\alpha+\frac{\beta}{f})\pi\tau\psi L_0 - \frac{\beta}{f}\pi(2-\pi)\underline{S}(1-f) > E_0 \geq \left(\alpha + \frac{\beta}{2f}\right)\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f)$.
- Uncorrelated diabolic loop: $\left(\alpha + \frac{\beta}{2f}\right)\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f) > E_0 \geq \frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f)$.
- Contagion region: $\frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f) > E_0$.

The argument goes as follows. Suppose that $\frac{\tau\psi L_0}{2} > \underline{S}(1-f)$. Then, when only one country recapitalizes, Case a is not possible because (2.16) and (2.17) imply that

$$\underline{S}(1-f) \geq \frac{\tau\psi L_0 - \alpha\pi\tau\psi L_0}{2(1-\alpha\pi)} = \frac{\tau\psi L_0}{2},$$

which is a contradiction. A similar argument implies that when both countries recapitalize, Cases a and b are not possible. Therefore, the boundaries of the regions when only one country recapitalizes and when both countries recapitalize are defined by Cases b and c, respectively.

Case 2 (high subordination): $\tau\psi L_0 > \underline{S}(1-f) > \frac{\tau\psi L_0}{2}$. There are four regions, as follows:

- No diabolic loop: $E_0 \geq (\alpha\pi + \frac{\beta}{f}\pi^2)\tau\psi L_0 - \frac{\beta}{f}\pi^2\underline{S}(1-f)$.
- Diversification region: $(\alpha\pi + \frac{\beta}{f}\pi^2)\tau\psi L_0 - \frac{\beta}{f}\pi^2\underline{S}(1-f) > E_0 \geq \alpha\pi\tau\psi L_0$.
- Uncorrelated diabolic loop: $\alpha\pi\tau\psi L_0 > E_0 \geq \max\{\frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f), 0\}$.
- Contagion region: $\max\{\frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f), 0\} > E_0$.

The argument goes as follows. Suppose that $\underline{S}(1-f) > \frac{\tau\psi L_0}{2}$. Then, when only one country recapitalizes, the maximum value of E_0 must belong to Case a. Indeed, if it belongs to Case b, then (2.19) implies that it must be equal to

$$E_0 = \left(\alpha + \frac{\beta}{2f}\right)\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f).$$

Under that value, (2.21) holds if and only if

$$\underline{S}(1-f) < \frac{\tau\psi L_0 - \left(\alpha + \frac{\beta}{2f}\right)\pi\tau\psi L_0 + \frac{\beta}{f}\pi\underline{S}(1-f)}{2(1-\alpha\pi)}$$

which is equivalent to $\frac{\tau\psi L_0}{2} > \underline{S}(1-f)$ and hence implies a contradiction. Hence, the maximum value of E_0 is as in Case a, i.e., $E_0 = \alpha\pi\tau\psi L_0$. A similar argument implies that when both countries recapitalize, the maximum value of E_0 must belong to Case b. The latter argument uses both inequalities, i.e., $\tau\psi L_0 > \underline{S}(1-f) > \frac{\tau\psi L_0}{2}$.

Case 3 (very high subordination): $\underline{S}(1-f) > \tau\psi L_0$. There are three regions, as follows:

- No diabolic loop: $E_0 \geq \alpha\tau\psi L_0$.
- Uncorrelated diabolic loop region: $\alpha\pi\tau\psi L_0 > E_0 \geq \max\{\frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f), 0\}$.
- Contagion region: $\max\{\frac{\beta}{2f(1-\alpha\pi)}\pi\tau\psi L_0 - \frac{\beta}{f}\pi\underline{S}(1-f), 0\} > E_0$.

The argument is similar to the preceding ones. Suppose that $\underline{S}(1-f) > \tau\psi L_0$. Then, when only one country recapitalizes, the maximum value of E_0 must belong to Case a. And when both countries recapitalize, the maximum value of E_0 must also belong to Case a.

We can fix $\gamma := \alpha + \beta$, and plot the regions in the $(E_0, \beta))$ space. Panels B and C in Figure 10 of the main paper correspond to Cases 1 and 2 respectively. Case 3 represents the limiting case in which the diversification region and (for very high $\underline{S}(1-f)$) the contagion region disappear. The boundary between the no diabolic loop and the diversification regions, and the boundary between the diversification and the single diabolic loop regions, are straight lines. Assumption 2.1 ensures that these lines have negative slope.

Table 1: Loss given default rates (in %) in the "higher LGDs" calibration (Subsection 1.1)

Country	Benchmark calibration				"Higher LGDs" calibration			
	lgd1	lgd2	lgd3	Average LGD	lgd1	lgd2	lgd3	Average LGD
Germany	40.0	32.0	20.0	36.1	46.0	36.8	23.0	41.7
Netherlands	40.0	32.0	20.0	37.0	46.0	36.8	23.0	42.5
Luxembourg	40.0	32.0	20.0	37.5	46.0	36.8	23.0	43.1
Austria	45.0	36.0	22.5	41.0	51.8	41.4	25.9	47.5
Finland	45.0	36.0	22.5	41.0	51.8	41.4	25.9	47.5
France	60.0	48.0	30.0	54.8	69.0	55.2	34.5	62.8
Belgium	62.5	50.0	31.3	56.3	71.9	57.5	35.9	64.7
Estonia	67.5	54.0	33.8	60.6	77.6	62.1	38.8	69.9
Slovakia	70.0	56.0	35.0	62.3	80.5	64.4	40.3	71.7
Ireland	75.0	60.0	37.5	67.4	86.3	69.0	43.1	77.3
Latvia	75.0	60.0	37.5	65.6	86.3	69.0	43.1	75.4
Lithuania	75.0	60.0	37.5	65.7	86.3	69.0	43.1	75.5
Malta	78.0	62.4	39.0	68.1	89.7	71.8	44.9	78.3
Slovenia	80.0	64.0	40.0	69.3	92.0	73.6	46.0	79.6
Spain	80.0	64.0	40.0	69.3	92.0	73.6	46.0	79.6
Italy	80.0	64.0	40.0	68.8	92.0	73.6	46.0	79.1
Portugal	85.0	68.0	42.5	68.8	97.8	78.2	48.9	79.1
Cyprus	87.5	70.0	43.8	64.3	100.0	80.0	50.0	73.9
Greece	95.0	76.0	47.5	61.7	100.0	80.0	50.0	70.2
Average	59.4	47.6	29.7	52.3	68.2	54.5	34.1	60.1

Note: This table reports the LGD inputs used in the numerical simulations described in Subsection 1.1, as compared with those used in the benchmark calibration of the simulation model reported in the main paper. The columns lgd1, lgd2 and lgd3 refer to the loss given default rates in state 1 (which is characterized by a severe recession), state 2 (mild recession) and state 3 (macroeconomic expansion) respectively. By construction, $lgd1 = 1.25 \times lgd2 = 2 \times lgd3$ in both calibrations. The "average LGD" column reports the average LGD across the three states; this average is 15% higher in the "higher LGDs" calibration than in the benchmark calibration.

Table 2: Five-year expected loss rates (in %) in the "higher LGDs" calibration (Subsection 1.1)

Subordination	**0%**	**10%**		**20%**		**30%**		**40%**		**50%**	
Tranche		**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**
Germany	0.15	0.13	0.36	0.10	0.36	0.07	0.36	0.02	0.35	0.00	0.31
Netherlands	0.31	0.26	0.73	0.20	0.73	0.13	0.73	0.05	0.70	0.00	0.62
Luxembourg	0.31	0.26	0.72	0.20	0.72	0.13	0.72	0.05	0.70	0.00	0.62
Austria	0.58	0.51	1.22	0.42	1.22	0.30	1.22	0.15	1.22	0.02	1.13
Finland	0.58	0.51	1.22	0.42	1.22	0.30	1.22	0.15	1.22	0.02	1.13
France	1.25	1.17	1.99	1.06	1.99	0.93	1.99	0.76	1.99	0.52	1.98
Belgium	1.63	1.53	2.52	1.41	2.52	1.25	2.52	1.04	2.51	0.76	2.50
Estonia	2.11	2.00	3.02	1.88	3.02	1.71	3.02	1.50	3.02	1.21	3.00
Slovakia	2.36	2.26	3.29	2.13	3.29	1.96	3.29	1.74	3.29	1.44	3.28
Ireland	2.73	2.64	3.53	2.53	3.53	2.39	3.53	2.20	3.53	1.94	3.52
Latvia	3.93	3.79	5.21	3.61	5.21	3.39	5.21	3.08	5.21	2.69	5.18
Lithuania	3.92	3.78	5.19	3.60	5.19	3.37	5.19	3.07	5.19	2.68	5.16
Malta	4.51	4.37	5.76	4.20	5.76	3.97	5.76	3.67	5.76	3.28	5.73
Slovenia	5.63	5.47	7.07	5.27	7.07	5.01	7.07	4.67	7.07	4.21	7.05
Spain	5.63	5.47	7.07	5.27	7.07	5.02	7.07	4.67	7.07	4.21	7.05
Italy	6.47	6.28	8.18	6.05	8.18	5.74	8.18	5.33	8.18	4.79	8.16
Portugal	10.31	10.01	13.03	9.63	13.03	9.15	13.03	8.50	13.03	7.63	12.99
Cyprus	15.60	14.99	21.11	14.22	21.11	13.23	21.11	11.92	21.11	10.08	21.11
Greece	38.88	37.05	55.39	34.76	55.39	31.81	55.39	27.88	55.39	22.38	55.39
Pooled	**3.20**										
ESBies		**1.22**	**21.06**	**0.51**	**13.98**	**0.18**	**10.24**	**0.06**	**7.92**	**0.00**	**6.40**

Note: Table shows the five-year expected loss rates (in %) in the "higher LGDs" calibration described in Subsection 1.1. The first row refers to the subordination level, which defines the size of the junior tranche. The second row refers to the tranche type; "S" (in black) denotes the senior tranche and "J" (in gray) the junior tranche. The cell referring to 0% subordination is blank, since there is no tranching in this case: all bonds are *pari passu*. The remaining rows refer to the bonds of nation-states and, in the final row, the pooled security, which represents a GDP-weighted securitization of the 19 euro area nation-states' sovereign bonds.

Table 3: Default rates (in %) in the "higher PDs" calibration (Subsection 1.2)

Country	Benchmark calibration				"Higher PDs" calibration			
	pd1	pd2	pd3	Average PD	pd1	pd2	pd3	Average PD
Germany	5.0	0.5	0.0	0.4	5.8	0.6	0.0	0.4
Netherlands	10.0	1.0	0.0	0.7	11.5	1.2	0.0	0.8
Luxembourg	10.0	1.0	0.0	0.7	11.5	1.2	0.0	0.8
Austria	15.0	2.0	0.0	1.2	17.3	2.3	0.0	1.4
Finland	15.0	2.0	0.0	1.2	17.3	2.3	0.0	1.4
France	25.0	3.0	0.1	2.0	28.8	3.5	0.1	2.3
Belgium	30.0	4.0	0.1	2.5	34.5	4.6	0.1	2.9
Estonia	35.0	5.0	0.1	3.0	40.3	5.8	0.1	3.5
Slovakia	35.0	6.0	0.1	3.3	40.3	6.9	0.1	3.8
Ireland	40.0	6.0	0.1	3.5	46.0	6.9	0.1	4.1
Latvia	50.0	10.0	0.3	5.2	57.5	11.5	0.3	6.0
Lithuania	50.0	10.0	0.3	5.2	57.5	11.5	0.3	6.0
Malta	55.0	11.0	0.4	5.8	63.3	12.7	0.5	6.6
Slovenia	60.0	15.0	0.4	7.1	69.0	17.3	0.5	8.1
Spain	60.0	15.0	0.4	7.1	69.0	17.3	0.5	8.1
Italy	65.0	18.0	0.5	8.2	74.8	20.7	0.6	9.4
Portugal	70.0	30.0	2.5	13.0	80.5	34.5	2.9	15.0
Cyprus	75.0	40.0	10.0	21.1	86.3	46.0	11.5	24.3
Greece	95.0	75.0	45.0	55.4	100.0	86.3	51.8	63.3
Average	31.3	8.1	1.1	4.4	35.8	9.3	1.3	5.0

Note: This table reports the PD inputs used in the numerical simulations described in Subsection 1.2, as compared with those used in the benchmark calibration in the main paper. The columns pd1, pd2 and pd3 refer to the default rates in state 1 (which is characterized by a severe recession), state 2 (mild recession) and state 3 (macroeconomic expansion) respectively. The "average PD" column reports the average PD across the three states; this average is 15% higher in the "higher PDs" calibration than in the benchmark calibration.

Table 4: Five-year expected loss rates (in %) in the "higher PDs" calibration (Subsection 1.2)

Subordination	**0%**	**10%**		**20%**		**30%**		**40%**		**50%**	
Tranche		**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**
Germany	0.15	0.13	0.42	0.09	0.42	0.04	0.42	0.00	0.39	0.00	0.31
Netherlands	0.31	0.25	0.83	0.18	0.83	0.08	0.83	0.00	0.77	0.00	0.62
Luxembourg	0.31	0.25	0.83	0.18	0.83	0.08	0.83	0.00	0.77	0.00	0.62
Austria	0.58	0.48	1.41	0.37	1.41	0.22	1.41	0.07	1.35	0.00	1.15
Finland	0.58	0.49	1.41	0.37	1.41	0.22	1.41	0.07	1.35	0.00	1.16
France	1.25	1.13	2.29	0.99	2.29	0.80	2.29	0.56	2.28	0.26	2.24
Belgium	1.63	1.49	2.90	1.31	2.90	1.09	2.90	0.80	2.88	0.39	2.87
Estonia	2.11	1.95	3.47	1.76	3.47	1.52	3.47	1.20	3.46	0.77	3.45
Slovakia	2.36	2.20	3.79	2.00	3.79	1.75	3.79	1.42	3.78	0.96	3.76
Ireland	2.73	2.59	4.07	2.40	4.07	2.16	4.07	1.85	4.06	1.42	4.04
Latvia	3.93	3.70	5.99	3.42	5.99	3.05	5.99	2.57	5.97	1.94	5.93
Lithuania	3.92	3.69	5.96	3.40	5.96	3.04	5.96	2.56	5.95	1.93	5.90
Malta	4.51	4.27	6.62	3.98	6.62	3.60	6.62	3.10	6.61	2.46	6.55
Slovenia	5.63	5.35	8.13	5.00	8.13	4.56	8.13	3.96	8.13	3.19	8.07
Spain	5.63	5.35	8.13	5.01	8.13	4.56	8.13	3.96	8.13	3.19	8.07
Italy	6.47	6.15	9.41	5.74	9.41	5.21	9.41	4.51	9.41	3.61	9.33
Portugal	10.31	9.79	14.99	9.15	14.99	8.31	14.99	7.20	14.99	5.93	14.69
Cyprus	15.62	14.66	24.29	13.46	24.29	11.91	24.29	9.85	24.29	7.94	23.30
Greece	38.90	36.19	63.30	32.80	63.30	28.44	63.30	22.63	63.30	16.27	61.53
Pooled	**3.20**										
ESBies		**1.13**	**21.81**	**0.46**	**14.18**	**0.14**	**10.35**	**0.02**	**7.97**	**0.00**	**6.40**

Note: Table shows the five-year expected loss rates (in %) in the "higher PDs" calibration described in Subsection 1.2. The first row refers to the subordination level, which defines the size of the junior tranche. The second row refers to the tranche type; "S" (in black) denotes the senior tranche and "J" (in gray) the junior tranche. The cell referring to 0% subordination is blank, since there is no tranching in this case: all bonds are *pari passu*. The remaining rows refer to the bonds of nation-states and, in the final row, the pooled security, which represents a GDP-weighted securitization of the 19 euro area nation-states' sovereign bonds.

Table 5: Five-year expected loss rates (in %) in the "more recessions" calibration (Subsection 1.3)

Subordination	0%	10%		20%		30%		40%		50%	
Tranche		S	J	S	J	S	J	S	J	S	J
Germany	0.24	0.19	0.61	0.14	0.61	0.08	0.61	0.00	0.59	0.00	0.47
Netherlands	0.47	0.39	1.22	0.28	1.22	0.15	1.22	0.00	1.18	0.00	0.94
Luxembourg	0.47	0.39	1.22	0.28	1.22	0.15	1.22	0.00	1.18	0.00	0.94
Austria	0.83	0.71	1.94	0.56	1.94	0.36	1.94	0.13	1.89	0.00	1.67
Finland	0.83	0.71	1.94	0.56	1.94	0.36	1.94	0.13	1.90	0.00	1.67
France	1.83	1.68	3.20	1.49	3.20	1.25	3.20	0.93	3.19	0.50	3.16
Belgium	2.34	2.16	3.95	1.94	3.95	1.65	3.95	1.27	3.93	0.75	3.92
Estonia	2.98	2.80	4.67	2.56	4.67	2.26	4.67	1.86	4.66	1.32	4.65
Slovakia	3.22	3.03	4.89	2.80	4.89	2.50	4.89	2.11	4.88	1.56	4.87
Ireland	3.83	3.65	5.40	3.43	5.40	3.15	5.40	2.78	5.40	2.27	5.38
Latvia	5.15	4.90	7.40	4.59	7.40	4.18	7.40	3.66	7.39	2.95	7.35
Lithuania	5.14	4.89	7.39	4.58	7.39	4.18	7.39	3.65	7.38	2.94	7.34
Malta	5.91	5.65	8.18	5.34	8.18	4.93	8.18	4.39	8.18	3.69	8.12
Slovenia	7.00	6.72	9.54	6.37	9.54	5.92	9.54	5.31	9.54	4.52	9.48
Spain	7.02	6.73	9.56	6.38	9.56	5.93	9.56	5.32	9.56	4.53	9.50
Italy	7.86	7.53	10.77	7.13	10.77	6.61	10.77	5.92	10.77	5.01	10.71
Portugal	11.12	10.66	15.23	10.09	15.23	9.35	15.23	8.37	15.23	7.26	14.97
Cyprus	15.66	14.84	23.05	13.81	23.05	12.49	23.05	10.73	23.05	9.12	22.19
Greece	35.99	33.71	56.49	30.86	56.49	27.20	56.49	22.32	56.49	17.02	54.96
Pooled	**3.77**										
ESBies		**1.69**	**22.55**	**0.72**	**15.98**	**0.19**	**12.12**	**0.02**	**9.40**	**0.00**	**7.54**

Note: Table shows the five-year expected loss rates (in %) in the "more recessions" calibration described in Subsection 1.3. The first row refers to the subordination level, which defines the size of the junior tranche. The second row refers to the tranche type; "S" (in black) denotes the senior tranche and "J" (in gray) the junior tranche. The cell referring to 0% subordination is blank, since there is no tranching in this case: all bonds are *pari passu*. The remaining rows refer to the bonds of nation-states and, in the final row, the pooled security, which represents a GDP-weighted securitization of the 19 euro area nation-states' sovereign bonds.

Table 6: Conditional default probabilities (in %) (Subsection 1.4)

	Adverse calibration *conditional on a default by:*				**Very adverse calibration** *conditional on a default by:*			
	Germany	France	Spain	Italy	Germany	France	Spain	Italy
Germany	100	18	12	11	100	27	21	21
Netherlands	26	19	14	14	36	32	26	26
Luxembourg	25	20	14	14	36	32	26	26
Austria	28	22	16	16	38	34	28	27
Finland	28	22	16	16	38	33	28	27
France	46	100	28	27	61	100	47	47
Belgium	44	45	31	30	63	60	51	50
Estonia	46	47	32	32	63	61	52	52
Slovakia	70	69	62	61	93	92	90	89
Ireland	70	70	63	62	93	92	90	89
Latvia	72	72	65	64	93	93	90	90
Lithuania	72	72	65	64	93	93	90	90
Malta	73	73	66	65	93	93	90	90
Slovenia	75	74	68	67	94	93	91	91
Spain	81	77	100	67	94	93	100	89
Italy	84	79	72	100	95	94	91	100
Portugal	80	79	74	73	95	94	93	92
Cyprus	82	82	77	77	96	95	94	93
Greece	93	93	91	91	98	98	97	97

Note: Table shows the default probabilities of euro area nation-states (given in the rows of the table) conditional on the default of Germany, France, Spain or Italy (given in the columns). These conditional default probabilities are shown for the adverse calibration (described in Subsection 4.3 of the main paper) and the "very adverse" calibration (Subsection 1.4). Owing to the more aggressive contagion assumptions in the "very adverse" calibration, default probabilities conditional on the default of Germany, France, Spain or Italy increase monotonically relative to the adverse calibration. If Italy defaults, for example, Spain then has a probability of default of 89% in the "very adverse" calibration, up from 67% in the adverse calibration and 31% in the benchmark calibration. This underscores the severity of the "very adverse" calibration.

Table 7: Five-year expected loss rates (in %) in the "very adverse" calibration (Subsection 1.4)

Subordination	0%	10%		20%		30%		40%		50%	
Tranche		**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**	**S**	**J**
Germany	0.96	0.76	2.76	0.51	2.76	0.20	2.73	0.00	2.40	0.00	1.92
Netherlands	1.30	1.03	3.64	0.71	3.64	0.30	3.61	0.00	3.24	0.00	2.59
Luxembourg	1.30	1.03	3.64	0.71	3.64	0.30	3.61	0.00	3.24	0.00	2.59
Austria	1.63	1.36	4.08	1.02	4.08	0.59	4.06	0.16	3.83	0.00	3.26
Finland	1.63	1.36	4.08	1.02	4.08	0.59	4.06	0.16	3.83	0.00	3.26
France	3.20	2.87	6.18	2.46	6.18	1.93	6.18	1.26	6.12	0.47	5.94
Belgium	4.12	3.73	7.63	3.25	7.63	2.62	7.63	1.83	7.57	0.73	7.52
Estonia	4.67	4.30	8.00	3.83	8.00	3.24	8.00	2.48	7.96	1.43	7.91
Slovakia	7.92	7.32	13.38	6.56	13.38	5.59	13.38	4.34	13.30	2.66	13.19
Ireland	8.53	7.98	13.43	7.30	13.43	6.43	13.43	5.28	13.39	3.78	13.27
Latvia	9.10	8.51	14.42	7.78	14.42	6.83	14.42	5.59	14.37	3.98	14.23
Lithuania	9.10	8.51	14.41	7.77	14.41	6.82	14.41	5.59	14.36	3.97	14.22
Malta	9.64	9.08	14.71	8.38	14.71	7.47	14.71	6.28	14.69	4.75	14.53
Slovenia	10.43	9.86	15.54	9.15	15.54	8.24	15.54	7.02	15.54	5.48	15.38
Spain	8.30	7.87	12.22	7.32	12.22	6.62	12.22	5.69	12.22	4.50	12.11
Italy	8.47	8.03	12.48	7.47	12.48	6.76	12.48	5.80	12.48	4.58	12.37
Portugal	13.75	13.06	19.98	12.19	19.98	11.08	19.98	9.59	19.98	7.85	19.65
Cyprus	17.79	16.76	27.08	15.47	27.08	13.81	27.08	11.60	27.08	9.42	26.17
Greece	35.92	33.49	57.77	30.46	57.77	26.56	57.77	21.35	57.77	15.62	56.22
Pooled	**4.87**										
ESBies		**3.15**	**20.38**	**1.97**	**16.48**	**0.98**	**13.95**	**0.39**	**11.60**	**0.11**	**9.64**

Note: Table shows the five-year expected loss rates (in %) in the "very adverse" calibration described in Subsection 1.4. The first row refers to the subordination level, which defines the size of the junior tranche. The second row refers to the tranche type; "S" (in black) denotes the senior tranche and "J" (in gray) the junior tranche. The cell referring to 0% subordination is blank, since there is no tranching in this case: all bonds are *pari passu*. The remaining rows refer to the bonds of nation-states and, in the final row, the pooled security, which represents a GDP-weighted securitization of the 19 euro area nation-states' sovereign bonds.