On the design of Sovereign Bond-Backed Securities

Emilio Barucci

Department of Mathematics, Politecnico di Milano,

joint paper with Damiano Brigo, Marco Francischiello, Daniele Marazzina

Goals and main results

Goals:

- Analysis of the architecture of Sovereign Bond-Backed Securities
- Return of the different tranches and on their riskiness
- Role of correlation among defaults and of a non-zero recovery rate
- Loss distribution and the VaR associated of the tranches of the bond.
- Analysis of securitization without tranching

Main results:

- Debt weights rather than GDP weights renders a higher rate for all the tranches, in particular mezzanine and junior tranches.
- A positive recovery rate decreases the yield rate of senior tranches and increases the yield rate of junior tranches.
- Increasing the correlation level would increase the rate of senior tranches and decreases the rate of junior tranches. Similar result with a block correlation structure.
- Safety without tranching is reachable but junior bonds become significantly risky.

Outline

1. Motivation

The Euro crisis shook to the roots the European Monetary Union.
In a monetary union, national governments issue debt in a currency which is not their own.
Key issue: no bail-out clause contained in the Maastricht Treaty (art.123 and 125).

The European Systemic Risk Board (ESRB) promoted a High level task force on safe assets.
The Task force has advanced the proposal to build Sovereign Bond-Backed Securities (SBBS).
The European Commission issued a regulation proposal to enable the development of SBBS.

Senior tranches of SBBS would represent a low-risk asset characterized by high liquidity, low volatility and low credit risk in normal and crisis periods.

During the Euro crisis, four main strictly related issues emerged:

- the bank-State nexus involving banks located in countries characterized by a high public debt and detaining a large amount of government bonds, leading to a self-reinforcing negative spiral: banks were exposed to poor credit quality government bonds and, (weak) States were not able to bail-out banks. The balance sheet of banks deteriorated, credit crunch.
- the European money market fragmented preventing a fluent transmission of the monetary policy and inducing excess volatility: flight to quality.
- The banking system and financial intermediaries need a safe asset as an anchor to be used as a collateral. The stock of safest government bonds (e.g. German bonds) is not enough for the European banking system creating problems to banks looking for collateral.
- A deep and liquid market for low risk government bonds and a sound reference yield interest rate curve are missing in the Euro area.

A safe asset as senior tranches of SBBS could help to weaken the bank-sovereign vicious circle (banks hold a diversified portfolio), should provide a safe asset and a solid risk free rate curve.

SBBS have been deeply criticized:

- Moral hazard and redistribution of national risk from weak countries to solid countries. In a turbulent period, the market for SBBS might break down: moral hazard could arise through the bail-out of junior tranches in case the market does not buy them anymore.
- The introduction of this asset would have on the market for sovereign bonds. The safe asset should contribute to eliminate the misspricing and the turbulence due to the weak architecture of the Euro area but it should not interfere with the market evaluation of credit risk of the countries.
- The instrument can be a safe asset in normal time but not in crisis periods because of strong correlation. Investors may decide to sell the SBBS investing in bonds issued by safe countries.

2. The functioning of SBBS

SBBS structure

SBBS is a standard asset-backed security exploiting the two classical principles of securitization: diversification and tranching.

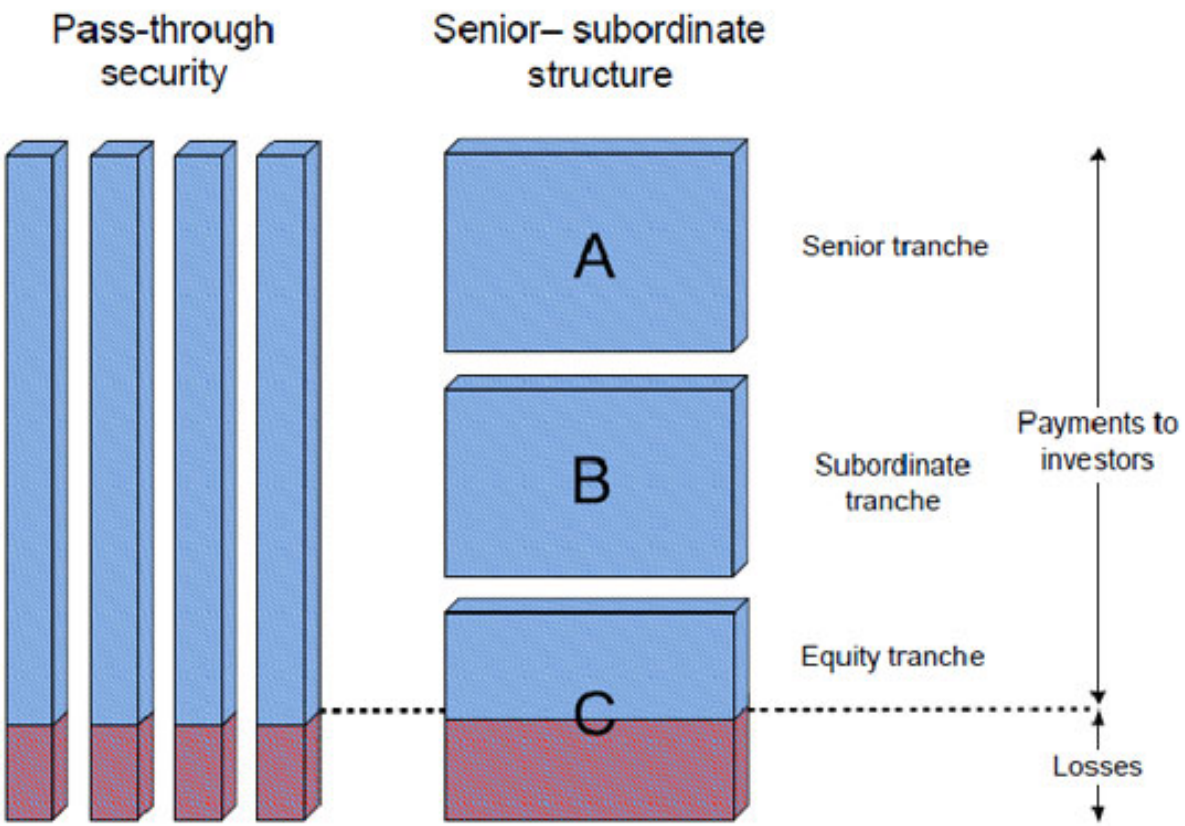
SBBS are built from a pool of sovereign bonds issued by EU member States (not necessarily adopting the Euro), bonds issued by local authorities and in other currencies are not allowed. Bonds are purchased by the vehicle on the market at market prices.

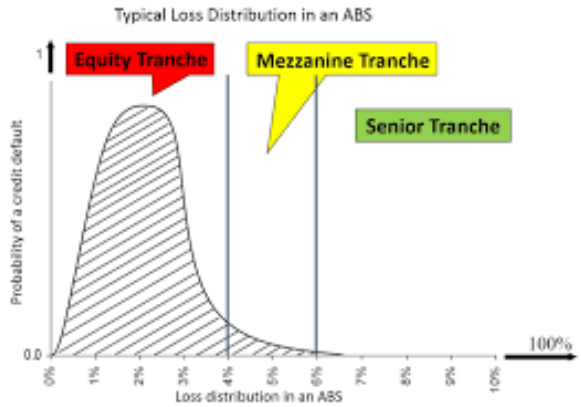
Weights of sovereign bonds are provided by the capital key of the ECB. Total issuance of SBBS would be limited to at most 33% of total outstanding stock of sovereign bonds.

SBBS are designed to render senior tranches almost risk-free. A tranching 70-20-10 would produce a senior tranche (70% of the pool) safe as the German bund. The 20% layer defines the mezzanine tranche, the 10% layer defines the junior tranche.

The market size of SBBS could be around 1.5 trillion euro.

Figure 1
Example of a Securitization Structure





Risk features

The Expected Shortfall in the worst 1% scenarios of senior tranches would be 9% while the expected loss for German bonds is 13%. The yield of the senior tranche of SBBS on October 2016 would have been 0.13%, while on the same date the yield of German sovereign bonds was 0.08%, see ESRB High-level task force on safe assets (2018) .

No single sovereign default would trigger the 30% threshold with a loss on senior tranches. If multiple defaults of countries occur in ascending order of their credit rating, then in case of a 100% loss given default (LGD), senior thanches would suffer a loss if Greece, Cyprus, Portugal, Italy and Spain default. In case of a LGD equal to 40%, even the default of Germany would be needed for the senior tranche to suffer a loss.

The average observed loss rate in sovereign debt restructuring historically is 37%. Considering this LGD, the five year expected loss rate of senior tranches of SBBS would be 0.5%. Riskiness of mezzanine (junior) tranches would be similar to that of lower investment grade (higher risk) Euro area sovereign bonds.

SBBS Return: benchmark model

As in ESRB High-level task force on safe assets (2018), we consider eleven countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain.
Zero-coupon 10Y yield rates provided by Thomson Reuters for January 31, 2019. 10Y risk-free discount rate is the one of the less risky State (German bonds).
Weights of the bonds included the SBBS portfolio are taken from the country average GDP during the period 2008-2017.

Country	Weight	Country	Weight
Austria	3.21%	Ireland	2.06%
Belgium	3.87%	Italy	16.22%
Finland	2.00%	The Netherlands	6.63%
France	20.88%	Portugal	1.77%
Germany	28.08%	Spain	10.73%
Greece	1.98%		

Procedure

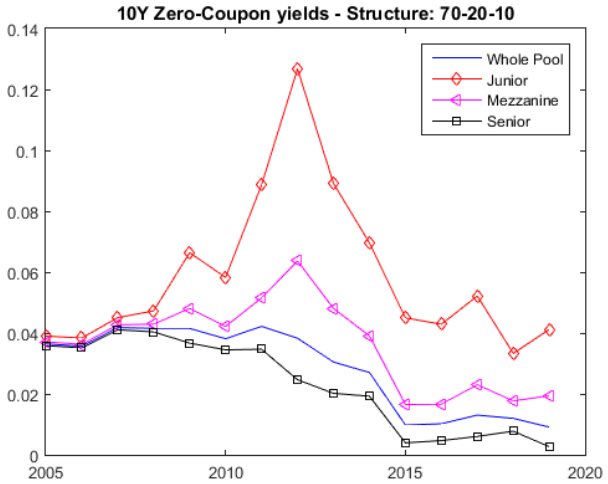
- From the zero coupon bonds data, we compute the 10 year default probability of each country.
- We simulate the default of each country in a 10 years horizon, correlating the single countries via a static Gaussian copula.
- As baseline we assume a 60% flat default correlation and no recovery rate.
- We simulate one million scenarios we then compute the loss on the zero coupon bond portfolio with a notional of 1 euro.
- For each scenario, we compute the losses of each tranche from the portfolio loss. We compute the yearly yields of the different tranches.

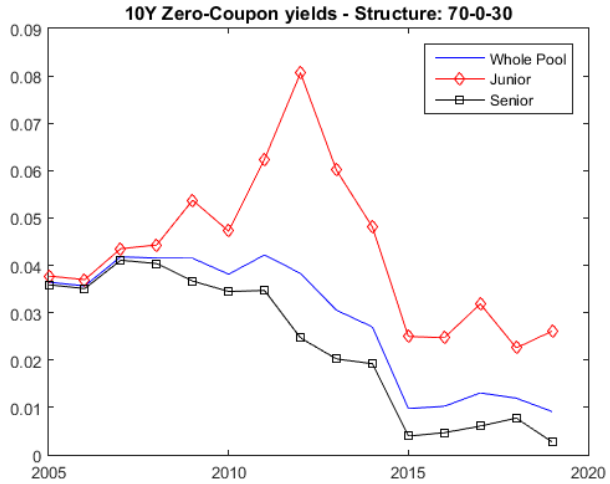
Results

Seniority	Senior	Mezzanine	Junior	Whole pool
70-20-10	0.27	1.94	4.12	0.92
80-10-10	0.38	2.76	4.12	0.92
70-0-30	0.27	-	2.62	0.92
80-0-20	0.38	-	3.43	0.92
90-0-10	0.62	-	4.11	0.92

Table: Yield rates of different tranches assuming GDP weights and no recovery rate. All data are in $\%$, i.e., 0.27 corresponds to 0.27%. 70-20-10 means that the senior tranche represents 70% of the asset pool.

Time evolution (2005-2019) of the different tranches considering 70-20-10 and 70-0-30 as tranching structure





The yield rates of the different tranches were very similar in 2005.
During the financial crisis, the junior tranche yield rate increased with a peak in 2012.
After 2012, in a low interest rate environment, prices of sovereign bonds started to include a default risk, the yield rates of the different tranches decreased but the dispersion among them increased.

3. On the design of SBBS

a. GDP or Debt weights?

SBBS weights deriving them from Public Debt of the countries: $[2.97\%,\ 4.56\%,\ 1.22\%,\ 21.50\%,\ 23.43\ 3.57\%,\ 1.99\%,\ 22.76\%, 4.68\%,\ 2.29\%,\ 9.81\%]$, and the total sum is 98.76%.

Seniority	Senior	Mezzanine	Junior	Whole pool
70-20-10	0.36	2.59	4.53	1.12
80-10-10	0.57	3.07	4.51	1.12
70-0-30	0.36	-	3.19	1.12
80-0-20	0.57	-	3.78	1.12
90-0-10	0.81	-	4.50	1.12

Table: Yield rates of different tranches assuming debt weights and no recovery rate.

As countries with a low credit quality also exhibit a significant public debt, debt weights lead to overweight countries with low credit quality. This leads to an increase of the yield rates.

The effect is limited for a SBBS without tranching (20 bps) and for senior bonds (around 10 bps), it is significant for junior (40 bps) and, in particular, for mezzanine tranches (more than 60 bps in case of 70-20-10 tranching).

b. Recovery rate

Recovery rate at 0.38 for all states (0.4 for Greece).
As we are fitting our model with non zero recovery rates, instead of zero recovery rates, to the same zero coupon bond market prices, we have different estimates for the implied survival probabilities: **lower survival probability**.

	AT	BE	FI	FR	DE	GR	IE	IT	NL
With recovery	0.94	0.91	0.95	0.93	1.00	0.50	0.89	0.64	0.97
No recovery	0.96	0.94	0.97	0.96	1.00	0.67	0.93	0.77	0.98

Table: Survival probabilities at 10Y computed from government bonds considering a positive recovery and a zero recovery rate.

An explanation: a little bit of arithmetic.
Indeed, to justify the same price when increasing the recovery, or equivalently lowering the loss given default, one has to increase the default probability or, equivalently, to decrease the survival probability:

$$Z = Z^{rf} \times (PS + REC \times (1 - PS)),$$

where:

- Z is the market price of the 10Y zero coupon bond
- Z^{rf} is the price of the 10Y risk-free zero coupon bond
- PS is the 10 years survival probability of the State issuing the bond
- REC is the recovery rate of the State.

A higher recovery rate corresponds to a smaller survival probability implied by the zero coupon bond price.

Seniority	Senior	Mezzanine	Junior	Whole pool
	GDP weights, Non Zero Recovery Rate			
70-20-10	0.17	1.59	6.29	0.92
80-10-10	0.26	2.42	6.32	0.92
70-0-30	0.17	-	2.91	0.92
80-0-20	0.26	-	4.15	0.92
90-0-10	0.47	-	6.29	0.92

Table: Yield rates of different tranches assuming GDP weights and non zero recovery rate.

A positive recovery rate has a significant effect on the yield rates of the tranches of SBBS.

The yield rate of SBBS without tranching is not affected by a positive recovery rate.

A positive recovery rate leads to a redistribution of default risk among tranches. The yield rate of junior tranches increases in a significant measure (even 200 bps), the yield rate of senior tranches decreases (between 10 and 25 bps depending on the tranching structure), the yield rate of mezzanine tranches decreases in most of the cases.

The rationale of this result is that a non-zero recovery rate implies a decrease of the survival probabilities obtained from the zero-coupon curve.

A positive recovery rate induces two different effects:

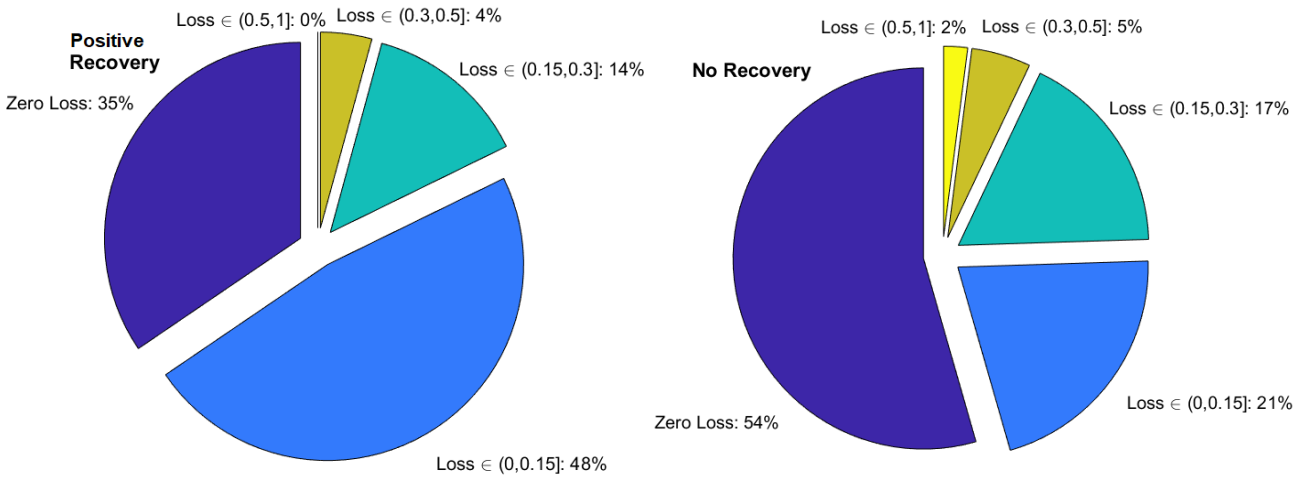
- A non zero recovery rate makes single defaults more likely
- it limits the loss due to the default of any country.

This makes the most junior tranche riskier, while puts an upper bound on the loss making senior and mezzanine tranches safer.

No recovery, there are more default-free simulations than the case where a positive recovery is considered (54% vs 35%).

A positive recovery makes more likely small losses, with a 0 probability of observing losses larger than 0.5.

A positive recovery rate: less simulations with a zero loss and more simulations with a small loss (below 0.30).



c. Level of correlation

	Uniform correlation 0.4			
70-20-10	0.22	1.91	4.76	0.92
80-10-10	0.32	2.89	4.78	0.92
70-0-30	0.22	-	2.78	0.92
80-0-20	0.32	-	3.78	0.92
90-0-10	0.57	-	4.77	0.92
	Uniform correlation 0.8			
70-20-10	0.33	1.94	3.50	0.92
80-10-10	0.45	2.64	3.51	0.92
70-0-30	0.33	-	2.43	0.92
80-0-20	0.45	-	3.05	0.92
90-0-10	0.67	-	3.50	0.92

Table: Yield rates of different tranches at various levels of uniform correlation. We assume GDP weights and zero recovery rates.

The yield rate of the SBBS without tranching is not affected by the uniform correlation level because it is determined only by the zero coupon prices extracted from market data.

The yield rate of senior tranches increases as the correlation increases while the yield rate of junior tranches decreases, the effect on mezzanine tranches is ambiguous depending on the tranching strcuture.

As the correlation among defaults increases a risk shifting phenomenon is observed from junior to senior tranches because the scenarios with many (few) defaults is more (less) likely.

For a high correlation, there are more simulations with a loss below 15% and especially more zero loss simulations, hence making the junior tranche safer. On the other hand, we also observe more simulations with a loss higher than 30%, hence making riskier the senior tranche.

d. Block structure

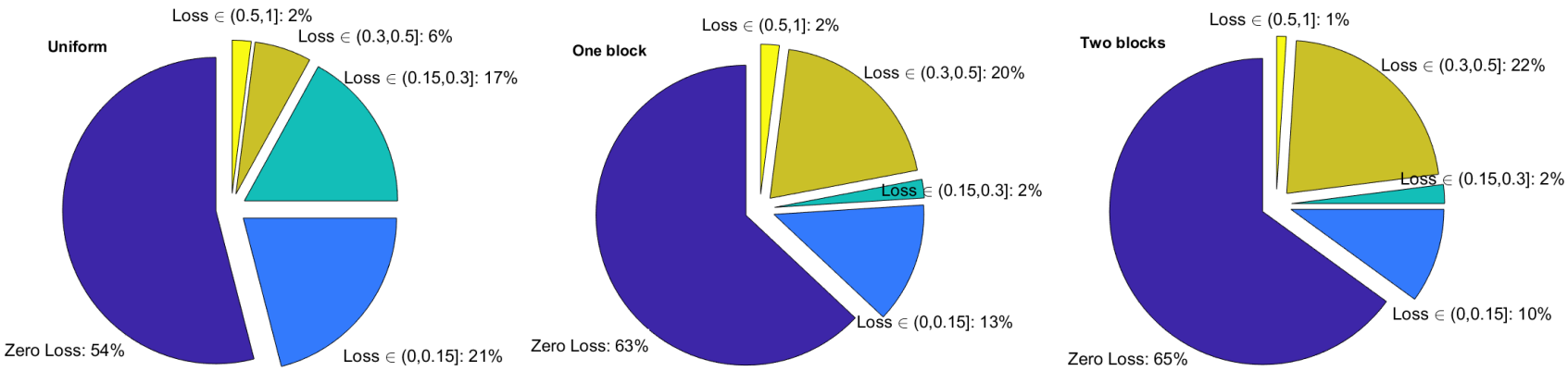
A high uniform correlation (1.00) among non-core countries (Portugal, Italy, Ireland, Greece, and Spain) and a low uniform correlation among the other States and among non-core countries and core countries (0.51) in such a way that the average correlation is 0.6 as in the benchmark case.

Decrease of the yield of the junior tranche, increase of the yield of senior and, in particular, of mezzanine tranches. The risk shifts from the junior tranches to the mezzanine ones and to a lesser extent to the senior ones.

Seniority	Senior	Mezzanine	Junior	Whole pool
70-20-10	0.29	2.17	3.41	0.92
80-10-10	0.44	2.81	3.41	0.92
70-0-30	0.29	-	2.57	0.92
80-0-20	0.44	-	3.11	0.92
90-0-10	0.67	-	3.41	0.92

Table: Yield rates of different tranches assuming GDP weights and zero recovery rate. Correlation 1.00 inside block (Portugal, Italy, Ireland, Greece, and Spain), correlation 0.51 outside block, average correlation 0.6.

We divide the countries in two blocks: non-core and other countries (Austria, Belgium, Finland, France, Germany, The Netherlands). Inside each block we assume a high correlation (1.00) and we assume a uniform correlation among countries of different blocks (0.27).
The results are similar to the single block one, shifting even more risk from junior to mezzanine and senior tranches.
We observe that there are more default-free simulations and more simulations above 30% assuming one of the two block structures than in case of uniform correlation; considering losses between 15% and 30% we observe more simulations in case of uniform distribution than in case of a correlation structure with blocks. We also notice that the loss distributions of the two different block structures are very similar.



e. Recovery rate and correlation

According to the previous analysis, a positive recovery rate and a higher correlation/block structure play opposite redistributive effects of risk among the tranches of SBBS.
We put them together (positive recovery rate and complex correlation structures). The results show that the positive recovery rate plays the dominant effect with a significant increase in the yield rate of junior bonds (always above 500 basis points) while the yield rate of the senior tranche, under different correlation structures, is always below 20 basis points.

Seniority	Senior	Mezzanine	Junior	Whole pool	Correlation
70-20-10	0.14	1.27	7.96	0.92	Uniform $\bar{\rho} = 0.2$
70-20-10	0.15	1.45	7.05	0.92	Uniform $\bar{\rho} = 0.4$
70-20-10	0.17	1.59	6.29	0.92	Uniform $\bar{\rho} = 0.6$
70-20-10	0.20	1.71	5.53	0.92	Uniform $\bar{\rho} = 0.8$

Table: Yield rate of the 70-20-10 SBBS with non zero recovery subject to different correlation structure specifications. $\bar{\rho}$ refers to the average correlation.

4. Safety without tranching

Safety without tranching

1. E-bonds. The safe asset would be issued by a senior, publicly owned financial intermediary, backed by a diversified portfolio of sovereign bonds purchased at face value (there is no tranching, seniority is given by the nature of the intermediary). Note that private bond holders would be subordinated to E-bonds and therefore the average cost of borrowing would increase. The weight of government bonds acquired is given by the minimum of a fraction of GDP and of a fraction of debt (up to 50% of debt and 25% of GDP). The ratios are determined under the assumption that the expected loss rate be equal to that of Germany under the adverse scenario.

2. National tranching followed by pooling. States issue senior and junior tranches. Then senior tranches are pooled together according to GDP or Debt weights to build an asset backed security. The subordination level at national level is 70%, that is junior bonds represent 70% of the amount issued by States and senior bonds represent 30%.

SBBS do a better job in case of a small crisis but would perform in a bad way in case of a systemic crisis.
Notice that this approach is successful in obtaining a safe asset but the drwaback is the significant increase of the yield rate of some countries, i.e., +140 bps for Italy, +60 bps for Spain.
Pooling government bonds of different States to build a safe asset renders junior bonds extremely risky. The yield rate of junior tranches of SBBS is significantly higher than the yield rate of junior bonds issued by Spain, France and Germany in case of pooling after tranching.

	SBBS		National Tranching			
Seniority	Senior	Junior	Junior IT	Junior ES	Junior FR	Junior D
30-0-70	0.13	1.27	0.13	4.11	1.88	0.79
40-0-60	0.13	1.47	0.19	4.74	2.12	0.87
50-0-50	0.13	1.77	0.43	4.74	2.12	0.87
60-0-40	0.14	2.22	0.59	4.74	2.12	0.87
70-0-30	0.17	2.91	0.70	4.74	2.12	0.87
80-0-20	0.26	4.15	0.79	4.74	2.12	0.87
90-0-10	0.47	6.29	0.86	4.74	2.12	0.87

5. Conclusions

Conclusions

- Considering Debt weights rather than GDP weights renders a higher rate for all the tranches, in particular mezzanine and junior tranches.
- Considering a positive recovery rate would decrease the yield rate of senior tranches and would increase the yield rate of junior tranches.
- Increasing the correlation level would increase the yield rate of senior tranches and would decrease the yield rate of junior tranches. Similar result for a block structure.
- The zero recovery rate assumption done in the analysis underestimates the risk of junior bonds yielding.
- Moral hazard issue underestimated.
- A safe asset can be obtained also without tranching at the cost of high spread of junior bonds.