Sovereign bond-backed securities: a feasibility study

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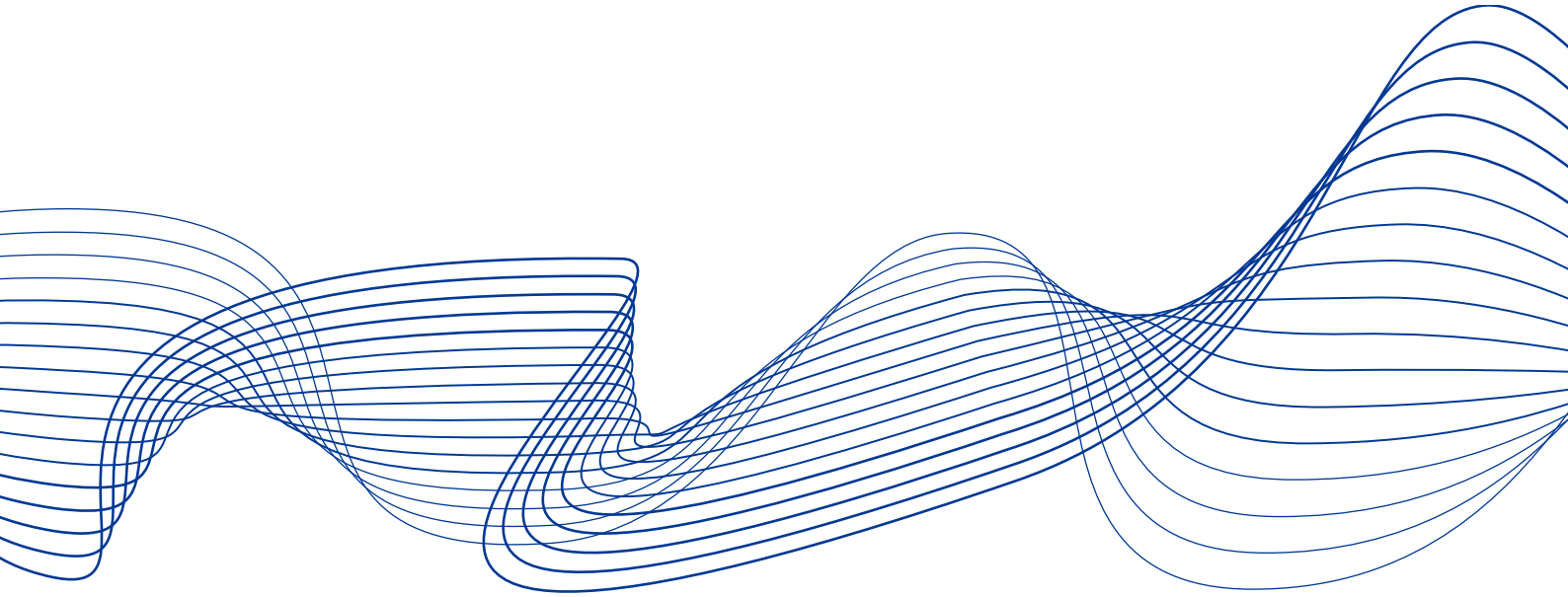
Volume II: technical analysis

by
ESRB High-Level Task Force on Safe Assets



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Executive summary

This second volume published by the ESRB High-Level Task Force presents technical analysis on aspects of sovereign bond-backed securities (SBBS) related to risk measurement, contractual features, market intelligence, market design and regulation. It is based on analysis conducted by the Task Force, its three workstreams and its liquidity and legal expert teams, in addition to intelligence gathered from interactions with market participants. This second volume of the Task Force's report therefore complements the first by providing a more technical analysis, which is warranted to shed light on the unique properties of SBBS. Together, the two volumes assess whether SBBS could achieve their policy objectives, the side-effects and risks that could ensue from their issuance, and the conditions under which a market for SBBS could feasibly develop.

Section 1 measures the risk properties of senior, mezzanine and junior SBBS. To that end, it subjects the securities to a series of stress tests to examine their robustness to the euro area sovereign debt crisis as well as even more severe hypothetical events. As such, the analysis abstracts from recent improvements to the euro area financial architecture and the fiscal positions of EU Member States and should therefore be interpreted as being much more conservative than typical supervisory stress tests. In simulations of hypothetical defaults, senior SBBS perform at least as well as the lowest-risk sovereign bonds in terms of their expected loss, value-at-risk, expected shortfall and expected loss conditional on tail events. By contrast, the performance of non-senior SBBS is more sensitive to measurement: both the mezzanine and junior securities perform relatively well in terms of expected loss and expected loss conditional on tail events, but appear riskier when measured by probability of default, value-at-risk, expected shortfall or sensitivity to systematic events. In the worst case, following defaults by multiple large sovereigns, junior SBBS could be completely wiped out, depending on recovery rates. The section then estimates yields on the three securities between 2000 and 2016 by implementing a pricing tool using historical market data. At the end of October 2016, the estimated yield on a 10-year 70%-thick senior SBBS is estimated to have been 0.13%, that of a 20%-thick mezzanine security 1.4% and that of a 10%-thick junior security 4.9%. These point estimates do not change significantly under different assumptions about key parameters (e.g. default correlation or LGD). The relative positions of mezzanine and junior SBBS compared to national sovereign bonds are stable historically. During 2011-12, for example, when sovereign risk was elevated, the risk of these securities relative to national sovereign bonds was similar to long-term averages.

Section 2 describes the contractual features of SBBS, focusing on a hypothetical sovereign debt restructuring event. The analysis conveys three main messages. First, contracts and the broader legal framework should be designed so that sovereign bonds in SBBS cover pools are treated in the same way as those held by investors directly. Equal treatment should also be ensured during any sovereign debt restructuring event. The treatment of bonds by a defaulting sovereign must therefore not discriminate according to whether investors hold sovereign bonds directly or through SBBS. Second, in a sovereign debt restructuring process, SBBS issuers would vote on the restructuring proposal based on instructions from a third-party trustee, which would have a fiduciary duty to act in the interests of all SBBS investors by maximising the value of their claim. Alternatively, issuers could aggregate votes submitted by SBBS holders. Third, in the case of a nominal haircut to principal or a reduction in coupon payments on sovereign bonds in a

hypothetical restructuring event, the modified bonds would replace the old bonds in the SBBS cover pool, thereby providing for equal treatment of investors in sovereign bonds and SBBS.

Section 3 summarises insights gained from market participants through three channels: discussions at a workshop at the Banque de France on 9 December 2016, responses to a survey posted on the ESRB website, and a series of meetings with market participants. The Task Force engaged through these channels with institutions that play a variety of roles in the financial system, including debt management offices, investment banks, commercial banks, asset managers, central counterparties and credit rating agencies. This engagement provided valuable feedback, with market participants conveying a range of views concerning the scarcity of safe assets, market microstructure, issuance, security design and investor demand, including both positive and sceptical assessments of SBBS. Overall, the feedback helped to shape the findings of the Task Force's feasibility study.

Section 4 discusses the design of an SBBS market, its liquidity and its interaction with sovereign debt markets. The key steps for the issuance of SBBS include: filling SBBS order books; assembling the underlying portfolio; establishing the issuer; and placing senior, mezzanine and junior SBBS with investors. The use of the order book ensures that SBBS-arranging entities only buy sovereign bonds to the extent that they receive orders for the securities. An arranger would also need to engage in other administrative tasks, including drafting prospectuses, liaising with credit rating agencies and conducting investor roadshows. In terms of institutional arrangements, SBBS arranger(s) could be multiple private sector entities or a single public institution (or a combination of both). Different considerations apply in each case. Competing private sector arrangers could generate efficiency gains, but would require regulation and supervision to ensure coordination and homogeneity of SBBS. In terms of a public sector arranger, the institutional setting would need to be designed to preserve market discipline and credibly preclude mutualisation of sovereign risks, which is a key tenet of SBBS. In either case, SBBS issuers would be bankruptcy-remote from arranger(s), and neither Member States nor European institutions would provide guarantees or paid-in capital for SBBS issuers or payment flows. Section 4 also outlines illustrative sizes of an SBBS market. The size of the market would be demand-led, with maximum limits set by policy, guided by liquidity in secondary markets for sovereign debt. In the early years of market development, one possible scenario would be to cap initial issuances at levels similar to debt securities issued by the European Stability Mechanism (ESM), which issued €10 billion of bonds in its first year. To achieve its policy objectives, however, the SBBS market would ultimately need to be large enough to facilitate portfolio diversification and de-risking by financial institutions. Achieving critical mass would depend on investor demand for the securities. In the medium-run, maximum market size could be guided by investor requirements in terms of portfolio diversification and de-risking, within constraints given by the impact of SBBS on sovereign debt market liquidity. A 33% issuer limit – somewhat analogous to the Eurosystem's public sector purchase programme (PSPP) – would imply a medium-run SBBS market size limit of approximately €1.5 trillion.

Section 5 evaluates the regulatory framework. Under existing regulation, SBBS would receive an unfavourable treatment compared with a portfolio of the underlying sovereign bonds. This unfavourable treatment is a powerful obstacle to the demand-led emergence of SBBS. A necessary condition for an SBBS market to emerge is for the securities to be treated in accordance with their unique design and risk properties, so that the treatment of senior SBBS would reflect their low-

riskiness, while junior and (to a lesser extent) mezzanine SBBS would be subject to relatively high capital charges or position limits. These parameters could be set in a dedicated SBBS product regulation, which would define the treatment of SBBS across financial sectors. Section 5 also analyses the implications for SBBS investor demand of the regulatory treatment of sovereign exposures (RTSE) under the current regime compared with reform options. This exercise does not evaluate the relative merits or drawbacks of each RTSE option and therefore does not pre-empt the outcome of policy discussions that are ongoing in other fora owing to their broader implications. This analysis concludes that capital charges for sovereign exposures that are sensitive to concentration or credit risk would substantially enhance the incentives for banks and insurers to purchase and hold senior SBBS, as they could use the security to mitigate the resulting impact of RTSE reforms on their capital requirements.

1 Risk measurement

This section contains a broad range of risk assessments and simulations that shed light on the properties of sovereign bond-backed securities (SBBS). Conditional and dynamic risk measures indicate whether senior SBBS are likely to remain low risk – even in adverse scenarios when the expected loss (EL) on junior and even mezzanine securities reaches high levels. This analysis can also help to ascertain whether there is likely to be investor interest in holding junior SBBS given their risk-return properties. In addition, comparing the respective SBBS risk attributes with those of a diversified portfolio of sovereign bonds highlights the effects of tranching as distinct from diversification.

The effects of diversification alone are assessed in Section 1.1. Historical prices indicate that a GDP-weighted, diversified portfolio of euro area sovereigns would have slightly lower volatility in daily returns than the lowest-risk individual sovereign. However, while diversification can lead to reduced volatility, it does not necessarily imply lower risk. Market-based measures other than volatility, such as kurtosis, show lower levels for the German sovereign bond than for the euro area portfolio. This motivates a more thorough risk assessment based on a broader set of measures.

After Section 1.1, risk exposures are measured in two distinct ways. The first approach simulates default scenarios with conservative assumptions about correlations, probabilities of default (PDs) and losses given default (LGDs). These parameters are calibrated in the spirit of a stress test and therefore do not reflect reality. The risk properties of SBBS can thereby be stress-tested using calibrations of a simulation model in which defaults are assumed to be likely and correlations high. The second approach regards observed historical risk premia as an indicator of time-varying ex ante PDs and generates dynamic loss distributions for SBBS based on whether simulations of correlated default scenarios exceed those implied by the historical yield premia. This enables SBBS yields to be estimated and holding period returns to be risk-assessed and compared with those on individual sovereigns and a diversified portfolio. Relatively conservative assumptions about default correlations serve to take into account potential contagion effects.

Sections 1.2 and 1.3 fit into the first of the methodological categories as they subject the simulation exercise of Brunnermeier et al (2017) to a stress test. In Section 1.2, the simulation model is calibrated to a series of adverse scenarios, including ones with higher LGDs, higher PDs, greater contagion, and a doubling in the frequency of severe recessions compared with the calibration in Brunnermeier et al (2017). In Section 1.3, the analysis extends the original assessments of Brunnermeier et al (2017) using a wider range of risk metrics (i.e. conditional expected loss (CEL), value-at-risk (VaR) and expected shortfall (ES)). This analysis reveals that senior SBBS have risk characteristics similar to those of the lowest-risk sovereign bonds – not only in terms of EL, but also when measured by 1% VaR and 1% ES. In fact, in the adverse calibration of the simulation model, senior SBBS are less risky than German sovereign bonds in terms of EL, 1% VaR and 1% ES. At the same time, the measured risk of junior SBBS is more sensitive to measurement, as Sections 1.2 and 1.3 explain. Naturally, these findings are conditional upon the effectiveness of the simulations in representing the true default generation process. This is where the second approach, based on historical data, has an advantage, as recent financial history includes a natural “stress test” of sovereign risk.

The subsequent analysis in Section 1 fits into the second of the methodological categories – being both dynamic and ex ante in nature. Section 1.4 provides estimated yields for SBBS that are used in the subsequent two sections. In particular, a copula approach is used to generate correlated default scenarios and the simulated loss distribution for senior, mezzanine and junior SBBS. Then, the sum of the observed yield premia of the individual sovereign bonds is allocated to each security according to its share in expected loss. Conservative assumptions about default correlation implicitly take into account potential contagion effects. This allows for an assessment of ex ante risks in SBBS using EL, VaR and ES. In terms of these risk measures, senior SBBS are similar to the lowest-risk sovereign bonds. For most seniority structures and maturities, the measured risk of mezzanine SBBS is close to that of medium-risk sovereign bonds. Junior SBBS are also generally of lower measured risk than the highest-risk sovereign.

Section 1.5 subjects the yield estimates from the previous section to a VAR-for-VaR (vector autoregressive model for VaR) and a marginal expected shortfall (MES) analysis. The VAR-for-VaR analysis reveals how the likelihood of extreme outcomes spills over from one asset to another. The MES analysis reveals how one asset is expected to fare in terms of expected outcome when another asset is likely to be experiencing a tail event. It therefore captures flight-to-safety dynamics (i.e. a positive outcome when some other asset experiences an extremely negative outcome). The results of this section broadly confirm those of previous sections. In particular, analysis reveals that senior SBBS benefit from a substantial flight-to-safety price premium, while there is a distinct lack of evidence for a flight-to-safety effect in the euro area portfolio. Junior SBBS in the standard 70-20-10 seniority structure have a risk exposure that is substantially below that of the riskiest single sovereign. Hence, the results are less negative for junior SBBS than in the theoretical simulations of Section 1.3, which measure unexpected losses in an ahistorical simulation model.

The results obtained in Sections 1.4 and 1.5 are summarised in Table 1.1. This table shows the nearest sovereign to the senior, mezzanine and junior SBBS in terms of their estimated yields and measured risk (i.e. EL, VaR, ES, VAR-for-VaR and GARCH-based volatility[1]). Across all of these measures, senior SBBS have risk properties similar to those of the lowest-risk sovereign bonds. Mezzanine SBBS are typically close to mid-ranked sovereign risks in terms of estimated yield, EL, VaR and ES. Importantly, this relative position of mezzanine SBBS appears to be reasonably stable in the time series: during 2011-12, their relative ranking remained similar to long-term averages. However, in terms of the GARCH volatility derived from the estimated SBBS yields, mezzanine SBBS exhibited slightly higher risk. By contrast, junior SBBS are closer to higher-risk sovereign bonds in terms of estimated yield and EL. Like the mezzanine security, junior SBBS also appear to have a reasonably stable relative ranking in the time series: their relative position during the 2011-12 crisis was similar to long-term averages. However, in the case of GARCH volatility during the crisis, their relative position deteriorated somewhat.

[1] GARCH-based volatility refers to an estimation of volatility using generalised autoregressive conditional heteroscedasticity.

Table 1.1

Senior, mezzanine and junior SBBS compared to national sovereign bonds

Risk measure	Time period	Senior security (70%-thick)	Mezzanine security (20%-thick)	Junior security (10%-thick)
Historical simulation (long-term averages)				
Yield and EL	2000-16	(DE = s) < FI	BE < (IT = m = ES) < IE	PT << j << GR
1% VaR	2000-16	NL < (DE = s = AT) < FR	ES < (IT = m) << IE	IE < (PT = j) << GR
1% ES	2000-16	FI < (DE = s = AT) < FR	ES < (IT = m) << IE	IE < (PT = j) << GR
Historical simulation (crisis times)				
Yield and EL	2011-12	DE < s < FI	BE < (IT = m) < ES	PT << j << GR
Yield and EL	June 2012	DE < s < FI	BE < (IT = m) < ES	PT << j << GR
1% VaR	2011-12	DE < (FR = s = NL) << BE	ES < (IT = m) << PT	IT << (j = IE) << GR
1% ES	2011-12	DE < (FR = s = NL) << BE	ES < (IT = m) << PT	IT << (j = IE) << GR
1% VAR-for-VaR	June 2012	DE = s = NL	ES = m < PT	PT < j < GR
GARCH volatility	June 2012	DE = s = FI	PT < m < GR	PT < GR < j

Source: ESRB calculations.
Note: The table summarises the results in Sections 1.4 and 1.5 for the standard 70-20-10 seniority structure. For each of the three securities, it describes how various risk metrics, i.e. yield, expected loss (EL), value-at-risk (VaR), expected shortfall (ES) and generalized autoregressive conditional heteroscedasticity (GARCH) volatility, compare with those of the closest national sovereign bond. For example, the entry "NL < (DE = s = AT) < FR" (for the 1% VaR averaged over 2000-16) indicates that the senior security has a higher absolute 1% VaR than the Dutch sovereign bond, a similar 1% VaR as German and Austrian sovereign bonds, and a lower absolute 1% VaR than the French sovereign bond. Note that while the VaR and ES values are negative, their absolute values are computed so that higher absolute values of VaR and ES indicate higher measured risk.

Section 1.6 supplements the risk spillover analysis with an assessment of interconnectedness among assets under different seniority structures using the methodology of Diebold and Yilmaz (2012), which accounts for the proportional contributions of shocks to (and from) chosen components of the market on the forecast-error variance of other parts of the market. This can identify which of the various seniority structures achieves the most efficient containment of risks. Rolling regressions reveal how these contributions change over time.

The analysis in this section cannot account for endogenous changes in risk following the introduction of SBBS. If risks were to endogenously decline following the introduction of SBBS, historical risk premia may exaggerate the required premia. Thus, the analysis may overstate the risk levels of SBBS. On the other hand, an opposing bias could theoretically arise from the flight-to-safety effect that exists in historical yields. These effects may endogenously become less significant in an environment where there is an ample supply of senior SBBS, which depends among other things on the market acceptance of senior SBBS relative to those of low-risk national sovereign bonds. The SBBS yield estimations conducted in Section 1.4 try to avoid this second type of bias by assuming a relatively high correlation of default. Accordingly, the calibration of the Monte Carlo method employed should mitigate the potential bias in the allocation of a safe-haven price premium to senior SBBS.

In general, historical yields are more informative when they include periods of financial stress, providing a better sample from which to generate simulations to capture extreme risks and

tail events. Using historical data has some advantages over simulation-based models as the latter are only reliable if their structural assumptions reflect the true default generation process.

1.1 Historical price volatility

Low-risk assets may be classified as those whose value remains relatively constant across time and economic cycles. This means that they exhibit low volatility, provided fundamental drivers of the general level of bond yields, such as inflation, remain relatively unchanged. Since sovereign debt default and restructuring remain tail events, an analysis of price or yield variations can help to illustrate the impact of stress in sovereign bond markets on the portfolios of banks and other investors. An assessment of the volatility of a basket composed of euro area sovereign bonds can also indicate to what extent banks could have benefited from diversification, before and during the crisis, in terms of asset price volatility.

This analysis comes with one important caveat: it is based on historical performances of sovereign bond yields in a specific market structure, where investors fled from some bonds to others depending on the economic conditions. How a more widespread holding of diversified portfolios (including via the SBBS issuer) would affect the performance of – and correlation between – bonds cannot be explored in this framework. Moreover, it should be noted that price volatility is just one risk measure. Later sections broaden the analysis to look at different risk measures of relevance to investors.

Between 2003 and 2016, a basket composed of euro area individual sovereign bonds[2] **(weighted by GDP), such as the one underlying issuances of SBBS, would have presented marginally lower yield variability –** as measured by the standard deviation of daily changes – than any individual sovereign bond (including that with the lowest yield volatility). This result is also observed for the period before the crisis (2003-06) and during the most intense stages of the crisis (2010-12).

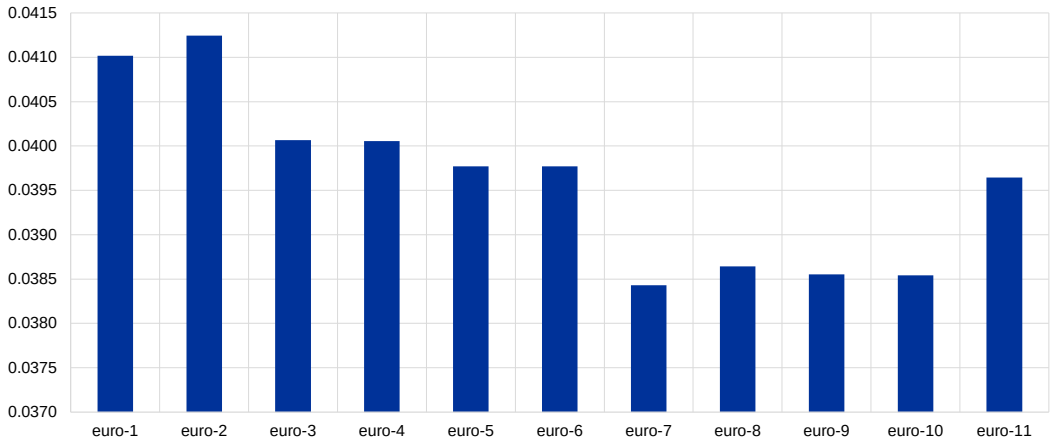
Another way of showing the gains from diversification in terms of volatility is to calculate them for different bond portfolios, where bonds are included according to their average volatility over the sample period (between January 2003 and October 2016). The euro-1 portfolio depicted in Figure 1.1 includes only bonds for the country with the lowest bond yield volatility, while portfolio euro-11 includes bonds from all countries in the sample (weighted by GDP). The gains from diversification are largest when bonds of seven or more countries are included in the underlying portfolio (see Table 1.1).

[2] For reasons of data availability, the simulation is based on yield data for 10-year government bonds of Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands and Portugal. Thus, this section on historical price volatility is in line with Section 1.4 that shows yield estimates for SBBS derived from historical simulation.

Figure 1.1

Average standard deviation of euro area sovereign bond portfolios

(in percent)



Sources: Thomson Reuters and ESRB calculations.
Note: The figure plots the average standard deviation of daily changes in yields between January 2003 and October 2016 on 11 different portfolios of euro area sovereign bonds. The first portfolio ("euro 1") contains sovereign bonds issued by the country with the lowest standard deviation (i.e. the Netherlands), the second portfolio ("euro 2") contains bonds issued by the two countries with the lowest standard deviation (i.e. the Netherlands and Germany weighted by GDP), and so on. In the data sample, standard deviation is minimised when the portfolio includes seven euro area countries (i.e. the "euro-7" portfolio).

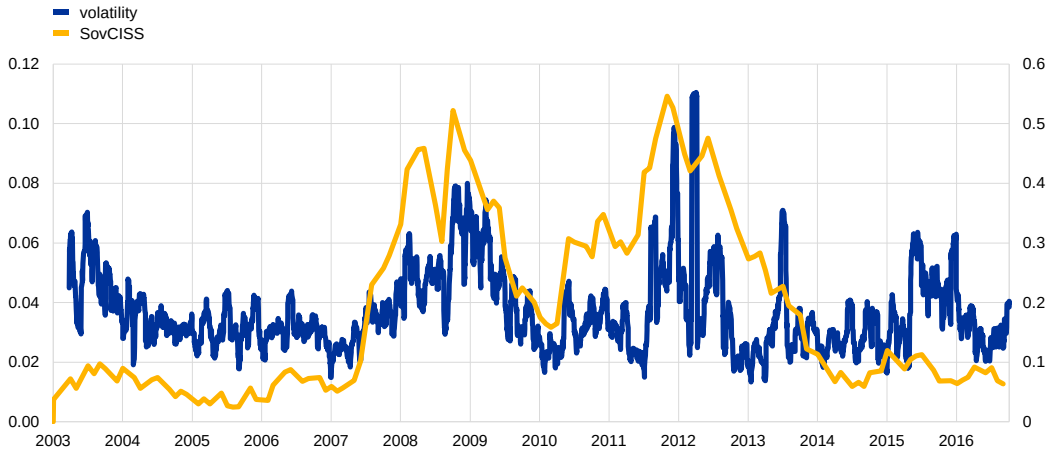
Realised volatility experienced sizeable changes over the sample period. In 2007, in the run-up to the financial crisis, volatility started rising for all euro area sovereign bonds, although with different magnitudes. The volatility in the diversified portfolio constructed for this analysis, which had been decreasing between 2004 and 2006, also increased as a consequence (see Figure 1.2). It peaked again at the beginning of 2012 with the intensification of the sovereign debt crisis and amid talks about private sector involvement in the restructuring of Greek government debt. Subsequent increases in volatility seemed less related to systemic shocks to the euro area sovereign debt market. The start of the Eurosystem asset purchase programme, the general bond repricing in the spring of 2015 and the crisis in Greece over the summer of 2015 had only a small impact on a sovereign composite indicator of systemic stress (SovCISS),[3] which summarises financial tensions in sovereign bond markets, while affecting the volatility of the portfolio more strongly.

[3] SovCISS measures the level of stress in euro area sovereign bond markets. It combines data from the short and long ends of the yield curve, including spreads against the euro swap rate, realised volatilities and bid-ask bond price spreads. While SovCISS is a composite indicator, it can also be broken down into country-specific indicators.

Figure 1.2

Volatility of a diversified portfolio and a composite indicator of financial stress

(left-hand axis is in percent; right-hand axis measures the SovCISS index)



Sources: Thomson Reuters and ESRB calculations.
Note: The figure plots the time series of volatility (left-hand axis) and SovCISS (right-hand axis). Volatility is measured as the moving 60-day standard deviation of daily changes in yields on a portfolio of 10-year benchmark euro area sovereign bonds weighted by GDP. SovCISS is a composite indicator of stress in sovereign bond markets.

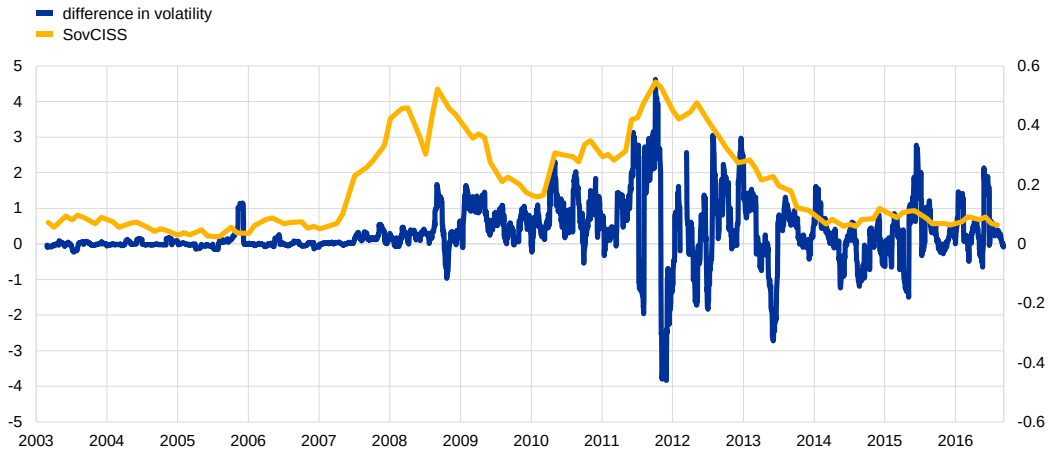
The volatility of the diversified portfolio was roughly similar to that of German sovereign bonds in the pre-crisis period, but lower on average during the crisis (see Figure 1.3). Its volatility in 2010 and 2011 may have been dampened by Eurosystem intervention in the government bond markets of Greece and Italy. The positive difference between German sovereign bond volatility and portfolio volatility persisted in 2012 and 2013 before the commencement of the Eurosystem's PSPP.

There are gains from diversification whenever the yield correlation is not perfectly positive. Gains increase as correlation falls. Bivariate regression coefficients, which act as a proxy for the impact of changes in one asset's yields on another asset's yields (conditional upon past information), show how the crisis contributed to a general dispersion in regression coefficients, which were all close to one until 2008. Some coefficients have remained quite stable among two main groups of countries (vulnerable/less vulnerable countries). This can indicate that they react similarly to common shocks, that there are idiosyncratic shocks that affect some particular groups of countries, or that contagion is greater within such groups. It thus shows evidence of fragmentation (with country clustering) in the euro area, including the flight-to-safety phenomenon observed at some points during the crisis, and consequent negative correlations across countries.

Figure 1.3

Difference in volatility between German sovereign bonds and a diversified portfolio of euro area sovereign bonds

(left-hand axis is in basis points; right-hand axis measures the SovCISS index)



Sources: Thomson Reuters and ESRB calculations.
Note: The figure plots the time series of differences in volatility (left-hand axis) and SovCISS (right-hand axis). Differences in volatility are measured as the moving 60-day standard deviation of daily changes in the 10-year benchmark German sovereign bond yield minus that of a portfolio of 10-year benchmark euro area sovereign bonds weighted by GDP. SovCISS is a composite indicator of stress in sovereign bond markets.

1.2 Stress tests of model-based simulation of losses

A low-risk asset is one that maintains its value even during stress scenarios. Its value is thus generally characterised by a negative correlation with the wider financial situation and even its own PD. In the euro area, daily changes in the yields on the sovereign bonds of Germany and the Netherlands were negatively correlated with their credit default swap (CDS) spreads between May 2010 and September 2012 (when the crisis intensified).

To be considered low risk, senior SBBS should be comparable to the lower-risk components of the underlying portfolio. This includes price changes and volatilities as well as pay-offs in the event of sovereign default. It is also important for senior SBBS to have strong credit ratings because they would compete with (even scarcer) highly rated sovereign bonds. However, minimising the risk by limiting the number of bonds in the underlying portfolio would imply a loss of the value from diversification (in terms of lower volatility and higher protection from idiosyncratic risks at all times) and a reduction in the supply of low-risk assets. Therefore, the estimation of the risk level of SBBS and their possible credit ratings are two important factors in the scheme.

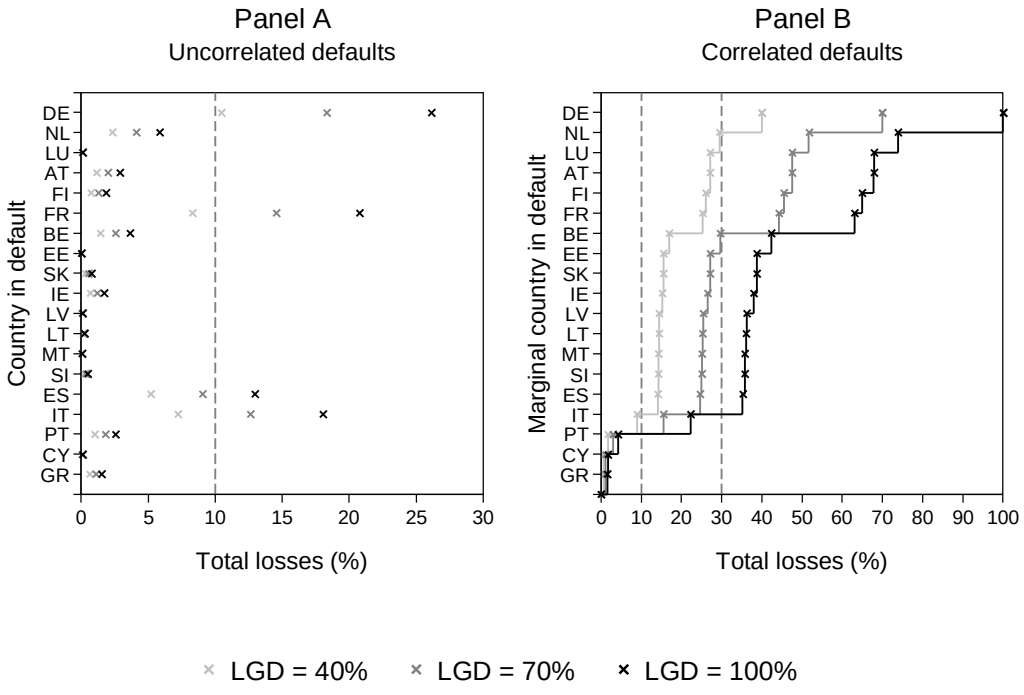
Hypothetical default scenarios

In the spirit of a rigorous stress test, the risk properties of SBBS are evaluated against a series of hypothetical default events. The results – shown for single-country defaults (Figure 1.4, Panel A) and multiple defaults (Panel B) – underscore the robustness of low-risk of senior SBBS to

most default events. First, Panel A reveals that a single idiosyncratic default is never sufficient to impose losses on 70%-thick senior SBBS, regardless of the assumed LGD rate. Even the worst case – namely a German default with 100% LGD – would impose losses of less than 30% on the entire SBBS construction (owing to Germany's weight of 26.15% in the SBBS cover pool). All losses would then be imposed on 10%-thick junior SBBS (for a 100% loss) and 20%-thick mezzanine SBBS (for a loss of 80.75%); senior SBBS would remain whole in this scenario. Second, with multiple defaults, the marginal defaulters with respect to senior SBBS are Spain (if LGDs are assumed to be 100%), France (if LGDs are assumed to be 70%) and Germany (if LGDs are assumed to be 40%) under the strong (but illustrative) assumption that countries default in ascending order of their credit rating. Taking a more plausible LGD rate of 37% – i.e. the average haircut on sovereign debt restructurings between 1978 and 2010[4] – implies that 70%-thick senior SBBS would not incur any losses even if all euro area countries except Germany were to default. Only if all 19 countries (including Germany) were to default would senior SBBS bear losses, which would amount to only 10%.

Figure 1.4

Hypothetical sovereign default scenarios and their effect on SBBS



Source: ESRB calculations.

Note: The figure shows total losses on the SBBS cover pool following a hypothetical default by a single country (Panel A) and defaults by multiple countries (Panel B) for three loss-given-default (LGD) rates (i.e. 40%, 70% and 100%).

[4] Using the "net present value" approach to calculating haircuts (as proposed by Sturzenegger and Zettelmeyer (2008)), Cruces and Trebesch (2013) report a mean haircut of 37% on 180 sovereign debt restructurings between 1978 and 2010.

The relative low-risk of senior SBBS is due to their embedded diversification combined with contractual subordination. This means that senior SBBS are protected by the subordinated securities during default events. The corollary of this protection is that the subordinated securities are proportionally more exposed to default events. For example, 10%-thick junior SBBS could incur losses of 100% if Germany were to default with an LGD of more than 38%. However, the subordinated securities are relatively more robust to defaults by smaller countries owing to their lesser weight in the SBBS cover pool. For example, assuming an LGD rate of 37%, 10%-thick junior SBBS could be subject to defaults by all countries except Germany, France, Italy and Spain and still have a positive recovery rate of 18.3%.

Robustness checks on the measurement of expected loss (EL)

Brunnermeier et al (2017) conduct numerical simulations to examine the risk characteristics of SBBS under benchmark and adverse calibrations of the model. The key result from these simulations is that 70%-thick senior SBBS have an EL rate similar to that of German sovereign bonds. In this section, the robustness of the findings of Brunnermeier et al (2017) is tested against more severe simulation design choices. In general, senior SBBS continue to perform well in the more severe calibrations: the EL rate of 70%-thick senior SBBS is similar to that of the German sovereign bond.

In particular, four alternative simulations are applied to stress-test the findings of Brunnermeier et al (2017):

1. **Higher LGDs:** In this variation, LGD rates increase by 15%. Conditional upon a sovereign's default, average losses imposed on bondholders are higher than under the benchmark and adverse scenarios in Brunnermeier et al (2017).

2. **Higher PDs:** The distribution of default rates shifts to the right by 15%. All sovereigns are likelier to default than in the benchmark scenario envisaged by Brunnermeier et al (2017).

3. **More frequent severe recessions:** Severe recessions occur 10%, rather than 5%, of the time, while mild recessions occur 20%, rather than 25%, of the time. This scenario is much more pessimistic, since most defaults occur during severe recessions when PDs are elevated.

4. **Very adverse:** The adverse scenario in Brunnermeier et al (2017) is subject to more severe contagion assumptions. When Germany, France, Italy or Spain defaults, others are even more likely to default. The default risk of senior SBBS depends strongly on correlations of default (as opposed to correlations of prices and yields) between underlying assets. Default correlations may be quite significant in crisis situations, meaning that this scenario may be particularly informative concerning the robustness of senior SBBS to extreme default events.

In general, senior SBBS continue to perform well in these more severe calibrations. In all scenarios, including the very adverse scenario, the EL rate of 70%-thick senior SBBS is similar to that of the German sovereign bond. This implies that SBBS are indeed able to generate low-risk assets with an appropriately conservative calibration of the seniority structure. Box 1.A quantifies the volumes of low-risk assets that may be generated by SBBS in comparison with nationally tranched bonds.

1.2.1 Stress test (1): higher loss-given-default (LGD) rates

In this variant, the benchmark calibration of Brunnermeier et al (2017) is repeated with LGD rates that are 15% higher. The new LGDs in each of the three states of the world – i.e. a severe recession, mild recession and macroeconomic expansion – are reported in Table 1.2.

In this calibration, five-year EL rates increase mechanically across the board, as shown in Table 1.3. Nevertheless, the three highest-rated Member States – Germany, the Netherlands and Luxembourg – remain comfortably below a 0.5% EL rate, with five-year EL rates of 0.15%, 0.31% and 0.31% respectively. 70%-thick senior SBBS have a five-year EL rate of 0.18%, which is similar to that of Germany.

The EL rate of junior SBBS increases from 9.10% in the benchmark calibration to 10.24% in the "higher LGDs" variant. Junior SBBS can still be sub-tranched to create a mezzanine security which could be attractive for more risk-averse investors. With 30% subordination, this can be achieved by splitting the junior security in half: the 15% mezzanine security has an EL rate of 3.42%, which maps to an investment grade credit rating of A-1 (i.e. ranked seven on a 1-22 rating scale); and the junior security has an EL rate of 17.07%, which is speculative grade.

1.2.2 Stress test (2): higher probabilities of default (PDs)

Here, default rates are 15% higher than in the benchmark calibration of Brunnermeier et al (2017). The new PDs are reported in Table 1.4.

Five-year EL rates increase across the board (Table 1.5), albeit by slightly less than in Section 1.2.1. 70%-thick senior SBBS have an EL rate of 0.14%, which is slightly lower than that of German sovereign bonds (0.15%). Likewise, the risk characteristics of the junior security are similar compared with Section 1.2.1: the EL rate at 30% subordination is 10.35%. With 50/50 sub-tranching, the 15%-thick mezzanine security has an EL rate of 3.39%, which implies an investment grade rating, while the corresponding junior security would have an EL rate of 17.31%.

1.2.3 Stress test (3): more frequent severe recessions

This robustness check assumes 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 than that of Brunnermeier et al (2017), since defaults are more likely to occur during severe recessions.

In this calibration, the EL rate of German sovereign bonds increases from 0.13% (in the benchmark calibration) to 0.24% (see Table 1.7). The EL rate of 70%-thick senior SBBS increases from 0.09% to 0.19%. They therefore remain slightly less risky than German sovereign bonds in terms of EL. The junior security is slightly riskier than in Sections 1.2.1 and 1.2.2, with an EL rate of 12.12%. Nevertheless, this junior security can be sub-tranched to create a 15%-thick mezzanine security (with an EL rate of 5.47%) and a higher-yielding junior security (18.78%).

1.2.4 Stress test (4): very adverse calibration

This section presents the results of a sensitivity analysis of the contagion assumptions that governs the adverse calibration of the simulation reported in Brunnermeier et al (2017). In particular, four contagion assumptions are made, imposed sequentially in the following order:

1. **Whenever there is a German default,** others default with 75% probability. (In Brunnermeier et al (2017), this probability is set at 50%.)

2. **Whenever there is a French default,** other Member States default with 75% probability, except the five highest-rated Member States, which default with 25% probability. (In Brunnermeier et al (2017), these probabilities are 40% and 10% respectively.)

3. **Whenever there is an Italian default,** the five highest-rated Member States default with 10% probability; the next three Member States (France, Belgium and Estonia) default with 25% probability; and the other Member States default with 75% probability – unless any of these Member States had defaulted at step 1 or 2. (In Brunnermeier et al (2017), these probabilities are 5%, 10% and 40% respectively.)

4. **Whenever there is a Spanish default,** the PDs of other Member States are the same as under an Italian default – unless any of these Member States had already defaulted.

These enhancements substantially increase the correlation of defaults across Member States. The first principal component of defaults now explains 57% of covariation in default rates, compared with 42% in the adverse calibration of the simulation model and 29% in the benchmark calibration. 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 1.7 shows the conditional PDs, which have the feature that euro area Member States are sensitive to the default of Germany, France, Italy or Spain. Five-year EL rates for national sovereign bonds are much higher than in the benchmark calibration. For German sovereign bonds, the EL rate is 0.96%. 70%-thick senior SBBS have an EL rate of 0.98% (see Table 1.8). Senior SBBS therefore continue to be similarly low-risk as German sovereign bonds in this calibration of the simulation.

Table 1.2

LGD rates in the "higher LGDs" calibration (Section 1.2.1)

(in percent)

	Benchmark calibration				"Higher LGDs" calibration			
Country	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	57.5	35.9	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**

Source: ESRB calculations.

Note: The table reports the LGD inputs used in the numerical simulations described in Section 1.2.1 compared with those used in the benchmark calibration of the model of Brunnermeier et al (2017). The columns lgd1, lgd2 and lgd3 refer to the LGD rates in state 1 (which is characterised by a severe recession), state 2 (mild recession) and state 3 (macroeconomic expansion) respectively. By construction, lgd1 = 1.25 × lgd2 = 2 × 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 1.3

Five-year EL rates in the "higher LGDs" calibration (Section 1.2.1)

(in percent)

Subordination	0%	10%		20%		30%		40%		50%	
Seniority		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**										
Senior SBBS		**1.22**	**21.06**	**0.51**	**13.98**	**0.18**	**10.24**	**0.06**	**7.92**	**0.00**	**6.40**

Source: ESRB calculations.
Note: The table shows the five-year EL rates (in %) in the "higher LGDs" calibration described in Section 1.2.1. The first row refers to the subordination level; the second row refers to the seniority of the security, where "S" denotes senior SBBS and "J" junior SBBS. The remaining rows refer to the bonds of Member States and, in the penultimate row, the pooled security, which represents a GDP-weighted portfolio of the 19 euro area Member States' sovereign bonds.

Table 1.4

PDs in the "higher PDs" calibration (Section 1.2.2)

(in percent)

	Benchmark calibration				"Higher PDs" calibration			
Country	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**

Source: ESRB calculations.
Note: The table reports the PD inputs used in the numerical simulations described in Section 1.2.2 compared with those used in the benchmark calibration of Brunnermeier et al (2017). The columns pd1, pd2 and pd3 refer to the default rates in state 1 (which is characterised 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, which is 15% higher in the "higher PDs" calibration than in the benchmark calibration.

Table 1.5

Five-year EL rates in the "higher PDs" calibration (Section 1.2.2)

(in percent)

Subordination	0%	10%		20%		30%		40%		50%	
Seniority		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**										
Senior SBBS		**1.13**	**21.81**	**0.46**	**14.18**	**0.14**	**10.35**	**0.02**	**7.97**	**0.00**	**6.40**

Source: ESRB calculations.
Note: The table shows the five-year EL rates (in %) in the "higher PDs" calibration described in Section 1.2.2. The first row refers to the subordination level; the second row refers to the seniority of the security, where: "S" denotes senior SBBS and "J" junior SBBS. The remaining rows refer to the bonds of Member States and, in the penultimate row, the pooled security, which represents a GDP-weighted portfolio of the 19 euro area Member States' sovereign bonds.

Table 1.6

Five-year EL rates in the "more recessions" calibration (Section 1.2.3)

(in percent)

Subordination	0%	10%		20%		30%		40%		50%	
Seniority		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**										
Senior SBBS		**1.69**	**22.55**	**0.72**	**15.98**	**0.19**	**12.12**	**0.02**	**9.40**	**0.00**	**7.54**

Source: ESRB calculations.
Note: The table shows the five-year EL rates (in %) in the "more recessions" calibration described in Section 1.2.3. The first row refers to the subordination level; the second row refers to the seniority of the security, where "S" denotes senior SBBS and "J" junior SBBS. The remaining rows refer to the bonds of Member States and, in the penultimate row, the pooled security, which represents a GDP-weighted portfolio of the 19 euro area Member States' sovereign bonds.

Table 1.7

Conditional PDs in the "very adverse" calibration (Section 1.2.4)

(in percent)

	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

Source: ESRB calculations.
Note: The table shows the PDs of euro area Member States (given in the rows of the table) conditional on the default of Germany, France, Spain or Italy (given in the columns). These conditional PDs are shown for the adverse calibration (described in Brunnermeier et al (2017)) and the "very adverse" calibration (Section 1.2.4). Owing to the more aggressive contagion assumptions in the "very adverse" calibration, PDs conditional on the default of Germany, France, Spain or Italy increase monotonically relative to the adverse calibration. This underscores the relative severity of the "very adverse" calibration.

Table 1.8

Five-year EL rates in the "very adverse" calibration (Section 1.2.4)

(in percent)

Subordination	0%	10%		20%		30%		40%		50%	
Seniority		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**										
Senior SBBS		**3.15**	**20.38**	**1.97**	**16.48**	**0.98**	**13.95**	**0.39**	**11.60**	**0.11**	**9.64**

Source: ESRB calculations.
Note: The table shows the five-year EL rates (in %) in the "very adverse" calibration described in Section 1.2.4. The first row refers to the subordination level; the second row refers to the seniority of the security, where "S" denotes senior SBBS and "J" junior SBBS. The remaining rows refer to the bonds of Member States and, in the penultimate row, the pooled security, which represents a GDP-weighted portfolio of the 19 euro area Member States' sovereign bonds.

Box 1.A
Supply of low-risk assets with SBBS and nationally tranched bonds

The financial stability objective of SBBS requires there to be an adequate supply of low-risk assets. Without it, SBBS' contribution to financial stability would be weakened. The generation of an adequate supply of low-risk assets is therefore an intermediate objective of SBBS. Achieving this objective is subject to the considerations outlined in other sections of this report. The purpose of this box is to evaluate the extent to which SBBS – once viably implemented and assuming sufficient investor demand – would contribute to the supply of low-risk assets, and how such supply compares with (i) the status quo and (ii) nationally tranched bonds.[5] Therefore, while the rest of Section 1 investigates whether senior SBBS would be sufficiently low risk, this box aims to quantify how many assets could be produced at a fixed, and sufficiently low, risk level.

For the purposes of this box, "low risk" is defined relative to the model-based EL rate of a portfolio comprising German, Dutch and Luxembourgish central government debt securities with portfolio weights of 81.3%, 18.3% and 0.4% respectively.[6] This portfolio has a five-year EL rate of 0.16% in the benchmark model of Brunnermeier et al (2017). For comparability, SBBS and senior national bonds are constructed to match this EL rate. For SBBS, this is achieved in the benchmark calibration with a subordination level of 27% and in the adverse calibration with a subordination level of 40%. For senior national bonds, the subordination level is set such that each country's senior security has a five-year EL rate of 0.16%.[7] For Germany, Luxembourg and the Netherlands, this holds at 0% by definition in the benchmark calibration; in the adverse calibration, the subordination level for these countries would need to be set at 28% to manufacture low-risk senior bonds with a weighted-average EL rate of 0.16%. For other countries, the subordination level varies from 33% for Austria and Finland in the benchmark calibration to 95% for Greece, rounding up to the nearest integer. With this approach, a portfolio of senior SBBS and a portfolio of senior national bonds have the same EL rate in both the benchmark and adverse calibrations of an internally consistent simulation model.[8] As such, their supply may be directly compared.

Figure A shows the results. The horizontal axis plots the face value of central government debt securities included in the portfolio(s) underlying SBBS or senior national bonds. A value of zero represents the status quo (in which neither SBBS nor senior national bonds exist). The vertical axis plots the total face value of all available low-risk securities (aggregated over senior SBBS and (senior) national bonds). In the benchmark model calibration, there are €1.54 trillion of low-risk assets under the status quo, shown by the red circle in the left-hand panel; in the adverse calibration, there are no low-risk assets. Both SBBS and senior national bonds increase the total volume of available low-risk assets. For SBBS, this increase is plotted by the solid black line. SBBS

5 For a fuller comparison of SBBS and nationally tranched bonds, see Van Riet (2017) and Leandro and Zettelmeyer (2018).

6 Clearly, admitting only Germany, the Netherlands and Luxembourg into the "low-risk" pool is conservative. Adopting a broader definition, in which more countries are included in the "low-risk" pool, does not change the qualitative findings about the relative supply of low-risk assets. The quantitative effect is to increase the intercept (red circle) in Figure A and to shift the black and grey lines upwards. These lines would continue to have a positive slope, albeit with a shallower gradient.

7 This contrasts with a uniform subordination level (of, say, 40%) as recommended by Wendorff and Mahle (2015). Notwithstanding its practical benefits of simplicity, uniform subordination would lead to senior national bonds of different riskiness, which complicates a like-for-like comparison of low-risk asset generation.

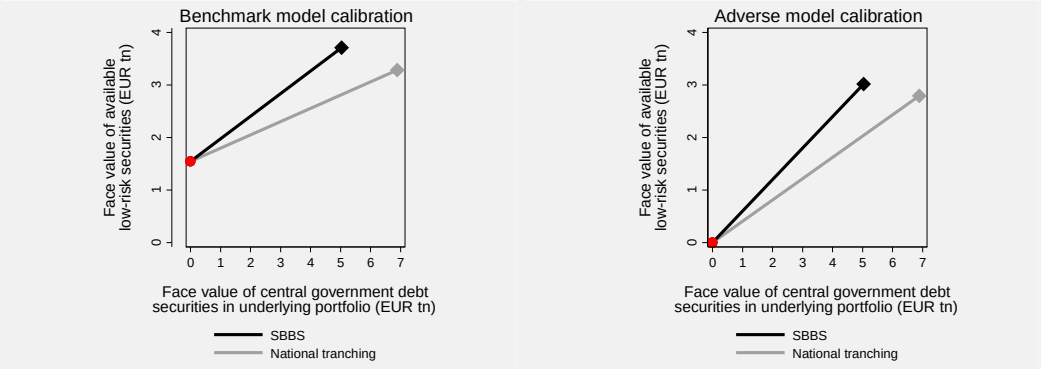
8 This analysis does not account for parameter uncertainty. A larger-than-expected loss following a sovereign default could cause a supposedly low-risk bond to bear losses. SBBS have greater robustness to uncertainty than national tranching.

are only generated in the region between €0 trillion and €5 trillion on the horizontal axis, since the latter represents the maximum possible size of the portfolio underlying SBBS (given ECB capital key weights). At this point, SBBS generate €3.71 trillion of low-risk securities in the benchmark calibration (given a 28% subordination level plus residual Dutch debt securities) and €3.02 trillion in the adverse calibration (given a 40% subordination level), as shown by the black diamonds.

Senior national bonds also generate more low-risk assets than the status quo (see the solid grey lines compared with the red circles). The design of these securities is unconstrained by the ECB capital key, so that the total stock of central government debt securities – i.e. €6.9 trillion – represents the maximum possible size of the portfolio underlying nationally tranched bonds. At this point, low-risk national senior bonds amount to €3.28 trillion of low-risk securities in the benchmark calibration and €2.79 trillion in the adverse calibration, as shown by the black diamonds. This is less than SBBS, which are more efficient than national tranching in generating low-risk assets.

Figure A

Low-risk asset supply with SBBS or senior national bonds



Source: ESRB calculations.
Note: The figure plots low-risk asset supply with SBBS or senior national bonds under the benchmark calibration (left-hand panel) and adverse calibration (right-hand panel) of the simulation model of Brunnermeier et al (2017). The red circle represents the status quo, in which SBBS and senior national bonds do not exist. In the benchmark calibration of the simulation model, there are €1.54 trillion of low-risk assets in the status quo; in the adverse calibration, there are no such assets. The black line plots the total volume of available low-risk assets as a function of SBBS market size. The grey line plots the total volume of available low-risk assets as a function of the market size of nationally tranched bonds.

To maintain sovereign bond market liquidity, the size of the SBBS market may be subject to an issuer limit (the Task Force did not consider whether this might also be needed under national tranching). With a 33% (50%) limit, the maximum size of the portfolio underlying SBBS would be approximately €1.5 trillion (€2.6 trillion), as explained in Section 4.3.3. At these levels, the total face value of available low-risk securities would be €2.2 trillion (€2.7 trillion) in the benchmark calibration and €0.9 trillion (€1.6 trillion) in the adverse calibration. The drop in low-risk securities from the benchmark to the adverse calibration is mostly because no national debt security is low-risk in the latter case; hence, only senior SBBS would contribute to the supply of low-risk securities.

The analysis presented in this box is theoretical in the sense that it abstracts from technical implementation and regulatory issues pertaining to SBBS (discussed elsewhere in this report) and senior national bonds (out of the scope of this report). Moreover, the generation of an adequate supply of low-risk assets is just one of several (intermediate) objectives of SBBS. Other objectives and considerations should be taken into account when deciding between policy options.

1.3 Stress tests of model-based simulations of unexpected losses

This section investigates the tail risk properties of senior and junior SBBS. Junior SBBS are the first loss piece of a diversified portfolio of euro area sovereign bonds. By construction, they are issued together with senior SBBS. Therefore, for senior SBBS to be issued, there must be sufficient demand for junior SBBS. Similar considerations apply with respect to the existence of a mezzanine layer.

The section builds on the simulation model of sovereign defaults adopted in Section 1.2 to quantify the risk properties of senior and junior SBBS in terms of "unexpected loss" and compare them to national sovereign bonds. As described in Section 1.2, the model builds on that in Brunnermeier et al (2017), who assess senior and junior SBBS in terms of EL rates. To extend that analysis, this section examines the simulation output using three alternative approaches: CEL, VaR and ES. These three measures capture: expected losses conditional on the macroeconomy being in a certain aggregate state (CEL); the portfolio losses that would occur at a given probability threshold (VaR); and the average portfolio losses that would be expected to occur when sovereign risk is in its tails (EL). Based on certain PD and LGD assumptions, these risk measures are calculated for senior, mezzanine and junior SBBS under different seniority structures.

- **For 70%-thick senior SBBS, these alternative risk measures confirm the low-riskiness suggested by the EL measure.** The 1% VaR of senior SBBS is 0% in the benchmark calibration of the simulation (the same as for German sovereign bonds) and 18% in the adverse calibration (lower than German sovereign bonds). The 1% ES of senior SBBS is 8.7% in the benchmark calibration and 25.7% in the adverse calibration, compared with 13.4% and 37.0% respectively for German sovereign bonds. Based on these measures, it could be inferred that the credit risk characteristics of senior SBBS are similar to (or slightly better than) those of German sovereign bonds.

- **For non-senior SBBS, these alternative risk measures paint a mixed picture.** If risk is measured by VaR at the 5% level, 20%-thick mezzanine SBBS has risk properties between those of Irish and Latvian sovereign bonds – a comparison that is more favourable than that implied by the EL measure. However, a 10%-thick junior SBBS has a 5% VaR of 100%, which is higher than Greek sovereign bonds, making the comparison with EL appear less favourable for the riskiness of junior SBBS. Moreover, with VaR at the 1% level, 20%-thick mezzanine SBBS are also riskier than Greek sovereign bonds, despite being comparable to Maltese sovereign bonds using the EL approach.[9] In terms of systematic risk, junior and to a lesser extent mezzanine SBBS are most sensitive to adverse economic conditions because the change in the EL rate from a mild to severe recession is greater than for higher-risk national sovereign bonds.

[9] Note that the overall result might change if assumptions about LGDs are more or less severe. If higher LGDs were applied to individual sovereign bonds, risk measures for these bonds would rise to make junior SBBS would look relatively more favourable. Nevertheless, estimates of haircuts based on historical data for sovereign defaults point to lower values (Cruces and Trebesch, 2013).

According to this analysis, the risk measures VaR and ES indicate that the riskiness of senior SBBS is the same or lower than that of German sovereign bonds, while the risk of junior SBBS could be higher than the risk of all other euro area sovereign bonds, depending on the measurement. The CEL rates suggest that junior SBBS and euro area sovereign bonds behave differently with respect to systematic risk. Besides considering the potential advantage of producing low-risk assets thanks to senior SBBS, it must be borne in mind that unexpected losses could result in junior SBBS being perceived as high-risk.

1.3.1 Background and simulation exercise

Section 1.2 assesses the riskiness of SBBS by comparing their performance with individual euro area sovereign bonds. Measurement of the risks of these instruments is based on EL rates, which are calculated after simulating the potential losses. However, because the loss distribution is heavy-tailed in adverse states of the world, it is also important to measure the risk properties of securities according to their unexpected losses. That is why the Basel III framework, for instance, requires banks to build up own funds to cover unexpected losses. This analysis therefore extends the simulations reported in Section 1.2, and first proposed by Brunnermeier et al (2017), of the quantitative properties of senior and junior SBBS with respect to measures of unexpected loss.

The simulation and input parameters (including PDs and LGDs) are the same as those in Brunnermeier et al (2017). To compare the performance of senior and junior SBBS to single-name euro area sovereign bonds, the benchmark and adverse calibrations of the simulation model are considered. The simulation output provides the losses for each instrument in each of the 10 million draws of the simulation. In a first step, this output is summarised by plotting histograms of the loss distributions on senior and junior SBBS. A subordination level of 30% is used for the simulation shown in Figure 1.5, implying that senior SBBS are 70% thick. If portfolio losses are 30% or less, senior SBBS do not incur any losses. Figure 1.5 shows that there is no case in which the loss rate on senior SBBS exceeds 40%, whereas junior SBBS suffer losses of 90% or higher in a non-negligible number of cases. In comparison, the highest losses that are possible for national sovereign bonds are borne by Greek bonds, with a maximum rate of 95% by assumption (see Figure 1.11).[10] In the adverse calibration, losses on junior SBBS are even more concentrated in the right tail of the distribution (see Figure 1.6). This suggests that the risk properties of junior SBBS and certain national sovereign bonds are different in the extreme tails of the loss distribution.

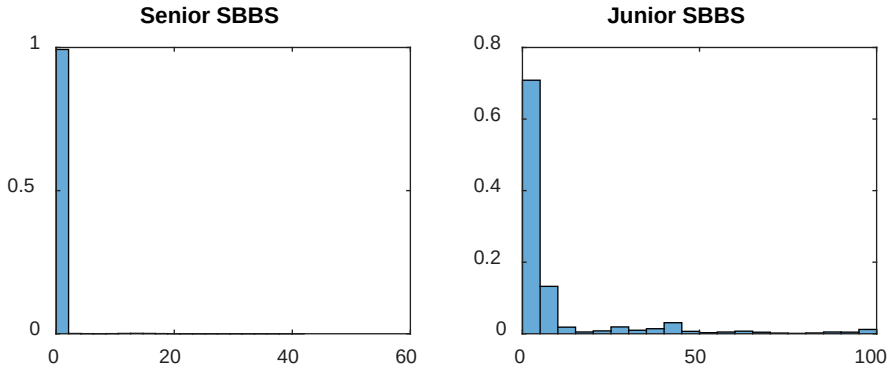
To quantify the risk properties of senior and junior SBBS compared with euro area sovereign bonds, the simulation output is analysed using three different approaches. The first approach assesses the sensitivity of the loss profile of the securities to the state of the economy; the second one calculates their VaR; and third one calculates the ES of the simulated loss distribution for senior and junior SBBS as well as individual euro area sovereign bonds.

[10] The simulation input chosen by Brunnermeier et al (2017) is also used here and contains assumptions about the LGD for each Member State in each aggregate state of the euro area economy. In the worst aggregate state, which describes a severe recession, it is assumed that Greece has an LGD of 95%. The LGDs for all other Member States are assumed to be smaller.

Figure 1.5

Histogram of losses in the benchmark calibration and with a 30% subordination level

(vertical axis measures frequency; horizontal axis measures losses in percent)

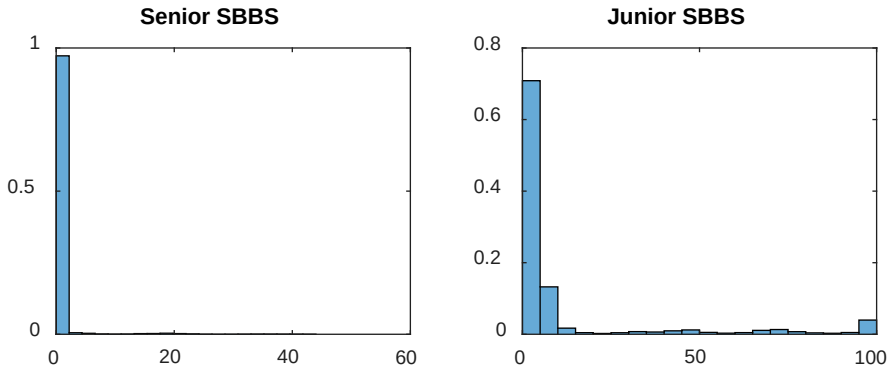


Source: ESRB calculations.
Note: The figure plots histograms of losses for 70%-thick senior SBBS (left-hand panel) and 30%-thick junior SBBS (right-hand panel) in the benchmark calibration of the simulation model of Brunnermeier et al (2017).

Figure 1.6

Histogram of losses in the adverse calibration and with a 30% subordination level

(vertical axis measures frequency; horizontal axis measures losses in percent)



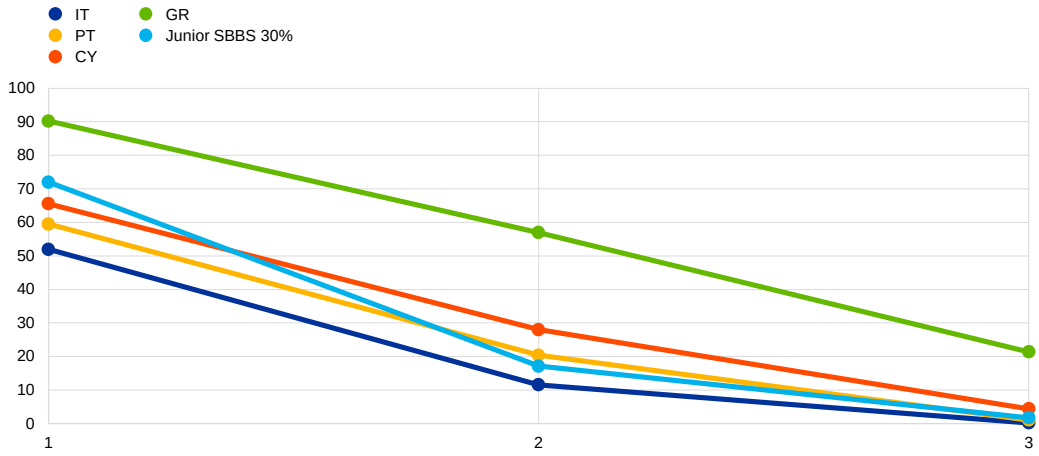
Source: ESRB calculations.
Note: The figure plots histograms of losses for 70%-thick senior SBBS (left-hand panel) and 30%-thick junior SBBS (right-hand panel) in the adverse calibration of the simulation model of Brunnermeier et al (2017).

1.3.2 Conditional expected loss (CEL) rates

This simulation exercise calculates the EL rates of junior SBBS and euro area sovereign bonds conditional on a certain state of the economy. The state of the economy is modelled as a random variable with three possible outcomes: severe recession, mild recession and expansion. The conditional expected loss (CEL) rates in the benchmark calibration are illustrated in Figure 1.7 for 30%-thick junior SBBS and for the four lowest-rated sovereign bonds of the euro area. This figure indicates that junior SBBS are more sensitive to a worsening of the aggregate state of the macroeconomy because the slope of the CEL rate from mild recession to severe recession is steeper than the slope of the lowest-rated national sovereign bonds. The same behaviour can be observed in the adverse calibration (see Figure 1.12).

Figure 1.7
EL rates conditional on the aggregate state of the euro area economy (benchmark model calibration)

(in percent)



Source: ESRB calculations.
Note: The figure reports the EL rates of junior SBBS compared with those of four national sovereign bonds (i.e. Italy, Portugal, Cyprus and Greece) conditional on the aggregate state of the euro area economy in a given draw of the benchmark calibration of the simulation model of Brunnermeier et al (2017). State 1 is characterised by severe recession, state 2 describes a mild recession and state 3 represents macroeconomic expansion.

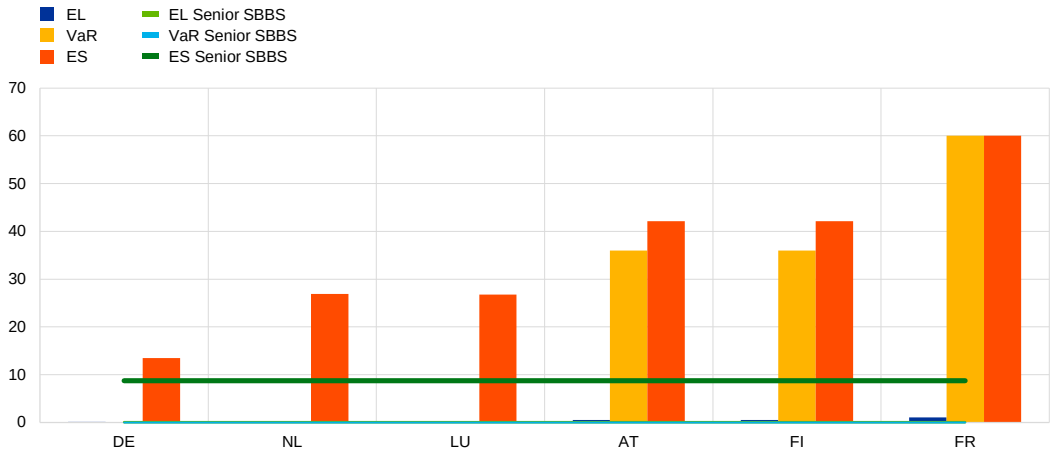
1.3.3 Risk measures: value-at-risk (VaR) and expected shortfall (ES)

This part of the simulation exercise concentrates on the tail of the simulated loss distribution of 30%-thick junior and 70%-thick senior SBBS compared with euro area sovereign bonds. Two widely used risk measures are quantified: VaR and ES. Both measures are calculated at a 1% level[11] and, for robustness, other levels. VaR measures the value of losses at which the probability that losses exceed this threshold is 1%. ES measures the EL of an instrument in the worst 1% of cases. Apart from VaR and ES, the simulation also calculates the EL rate for each instrument, as in Section 1.2. Figure 1.8 shows that senior SBBS' risk is equal to or lower than that of German sovereign bonds for all reported risk measures. The same is true in the adverse calibration of the simulation model (see Figure 1.13 and Table 1.10).

Figure 1.8

Risk measures for senior SBBS and national sovereign bonds (benchmark model calibration; VaR and ES at 1% level)

(in percent)



Source: ESRB calculations.
Note: The figure plots the EL, 1% VaR and 1% ES for senior SBBS and national sovereign bonds in the benchmark calibration of the simulation model of Brunnermeier et al (2017). EL rates are barely visible due to scaling.

The risk measures for junior SBBS and each national sovereign bond, as obtained in the benchmark calibration of the simulation model, are illustrated in Figure 1.9. The EL rate of junior SBBS is 9.1%. However, the picture is different when risk is measured by VaR or ES (see Table 1.9 and Table 1.10). Under the benchmark calibration of the simulation model, the VaR of junior SBBS is 98.5%, i.e. the loss rate of junior SBBS is higher than 98.5% in 1% of cases;[12] by comparison, the VaRs of all national sovereign bonds are lower. The VaRs of Greek and Cypriot sovereign bonds, for example, are 87.5% and 95% respectively. Similar results are obtained in the

[11] The standard 1% level is chosen because, for example, own funds requirements for market risk are calculated according to this level (see Article 365 of the CRR).

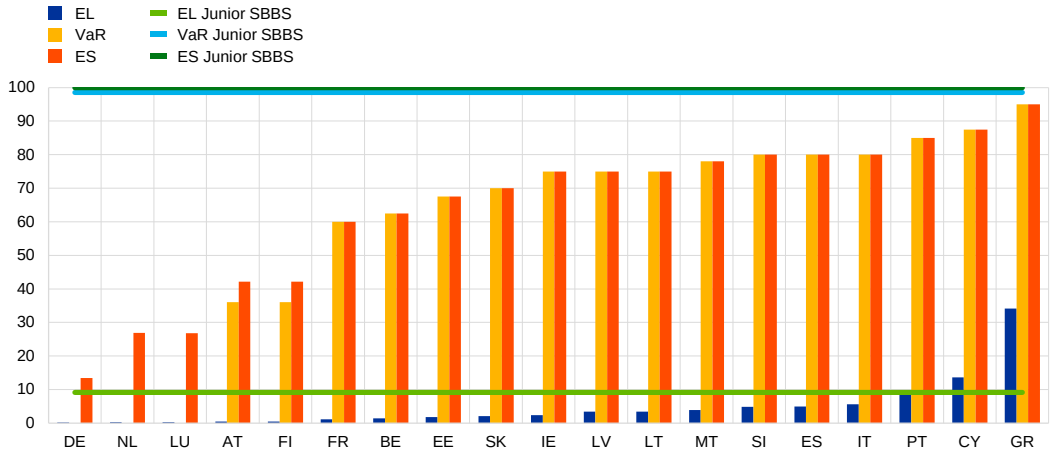
[12] This means that, if the investor holds an amount of €1 of the junior security, the loss is higher than €0.98 in 1% of cases.

adverse calibration of the simulation model (see Figure 1.14). Market participants would need to take these risk characteristics into account when pricing junior SBBS relative to national sovereign bonds.

Figure 1.9

Risk measures for junior SBBS and national sovereign bonds (benchmark model calibration; VaR and ES at 1% level)

(in percent)



Source: ESRB calculations.
Note: The figure plots the EL, 1% VaR and 1% ES for junior SBBS and national sovereign bonds in the benchmark calibration of the simulation model of Brunnermeier et al (2017).

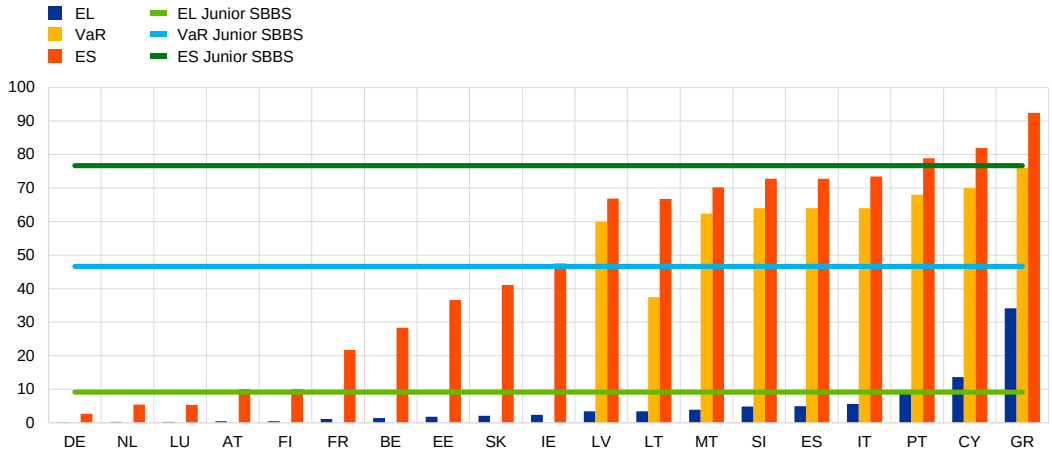
Similar findings emerge for ES, which at the 1% level for junior SBBS is 99.91%, higher than that of all other national sovereign bonds. The same hold true in the adverse calibration, since the VaR and ES of junior SBBS are 100% (see Figure 1.13 and Table 1.10).

VaR and ES depend heavily on the choice of the percentile of the distribution at which losses are evaluated. Figure 1.10 illustrates the results if higher percentiles are used, such as 5%. In this case, the risk measures are smaller due to the calculation of a lower percentile of the distribution (i.e. 95% instead of 99%). Measuring risk with VaR at the 5% level, for example, produces results for junior SBBS that make them comparable with mid-ranked national sovereign bonds, whereas ES at the 5% level indicates that junior SBBS are comparable to higher-risk national sovereign bonds.

Figure 1.10

Risk measures for junior SBBS and national sovereign bonds (benchmark model calibration; VaR and ES at 5% level)

(in percent)



Source: ESRB calculations.
Note: The figure plots the EL, 5% VaR and 5% ES for junior SBBS and national sovereign bonds in the benchmark calibration of the simulation model of Brunnermeier et al (2017).

The comparison of the risk properties of junior SBBS and national bonds is based on the PD and LGD assumptions made by Brunnermeier et al (2017). The overall results would change if assumptions were more or less severe. If higher LDGs are applied – e.g. 100% – the VaR of these national sovereign bonds would reach 100%, making junior SBBS look relatively more favourable. However, an LGD assumption of 100% is very severe: historical data on sovereign defaults suggest that LGDs are likely to be much lower (Cruces and Trebesch, 2013). If lower LGDs are assumed, junior SBBS could appear relatively less favourable (in terms of VaR and ES) than national sovereign bonds.

1.3.4 Risk properties of mezzanine SBBS

This report envisages a seniority structure comprised of 70%-thick senior SBBS, 20%-thick mezzanine SBBS and 10%-thick junior SBBS. Here, risk measures are calculated for two different seniority structures and reported in Table 1.9 for the benchmark calibration of the simulation model and in Table 1.10 for the adverse calibration.

Under the first structure (70-20-10), junior SBBS cover the first 10% of portfolio losses. If losses exceed this level, mezzanine SBBS will incur losses. Senior SBBS will be affected if portfolio losses exceed 30%. In both cases, and under all reported levels, the VaR and the ES of junior SBBS are 100%.

Under the benchmark calibration, and at the standard 1% level, the VaR and the ES of mezzanine SBBS are higher than those of all other euro area sovereign bonds. The VaR at 5% level indicates that the risk of mezzanine SBBS is higher than that of Irish sovereign bonds and considerably lower than that of sovereign bonds issued by Latvia. The same is true if ES is applied.

In the adverse calibration, the risk (in terms of VaR and ES at a 1% level) of mezzanine SBBS is higher than that of all other national sovereign bonds. If the VaR and ES are applied at a 5% level, the risk of mezzanine SBBS is comparable to that of national sovereign bonds of Cyprus.

As expected, the riskiness of mezzanine and junior SBBS are higher if the subordination level is lowered (e.g. in a 80-10-10 structure), as indicated in lines five to eight in Tables 1.9 and 1.10.

1.3.5 Conclusion

The appetite for junior SBBS depends on the risk preferences of investors. Results obtained following the approach of Brunnermeier et al (2017) show that the risk of junior SBBS depends on measurement. If one considers only EL rates, risk might be underestimated. In terms of VaR and ES, junior SBBS could be riskier than all other national sovereign bonds of the euro area because their recovery rate in extreme scenarios would be lower. Moreover, CEL rates indicate significantly different behaviour of junior SBBS and national sovereign bonds regarding systematic risk. From this perspective, the pooling and tranching of euro area sovereign bonds produces low-risk assets (senior SBBS) that are at least as low-risk as German sovereign bonds. As a by-product, it also produces assets (junior SBBS) which may be riskier than Greek sovereign bonds in terms of their VaR and ES. Thus, the risk properties of senior and junior SBBS should be considered when evaluating the potential investor bases for these securities.

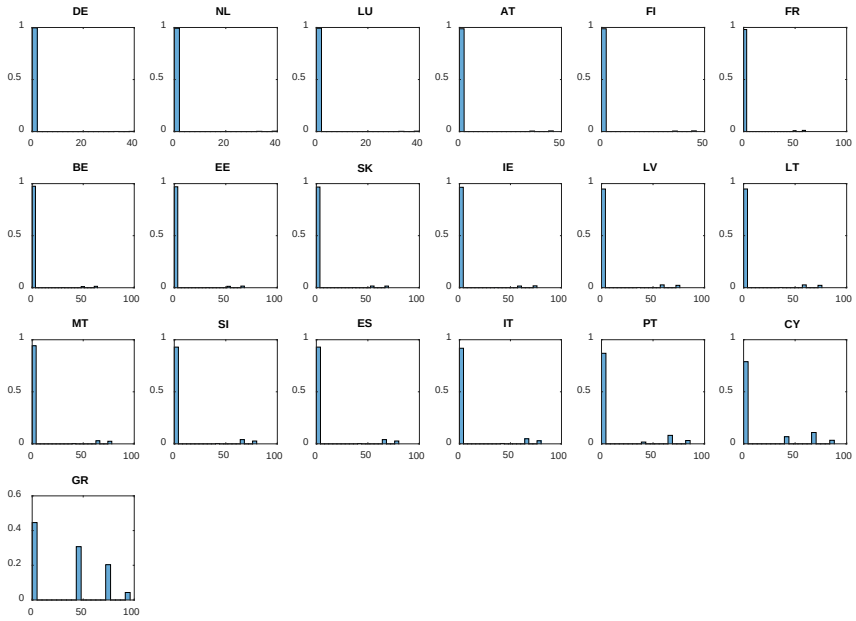
If the junior component is split in two, mezzanine SBBS could be desirable for a more risk-averse clientele. Sub-tranching implies lower risk in the mezzanine security but at the expense of higher risk in junior SBBS. Nevertheless, VaR and ES at the 1% level indicate that mezzanine SBBS could still be riskier than all other euro area sovereign bonds according to these risk measures, although not in terms of EL.

Risk measures are calculated based on the simulation model of Brunnermeier et al (2017), which does not capture endogenous effects of risk reduction. The true realisations of EL, VaR and ES might be lower if the implementation of SBBS were to reduce the nexus between sovereign risk and bank risk.

Figure 1.11

Histogram of losses on national sovereign bonds (benchmark model calibration)

(vertical axis measures frequency; horizontal axis measures losses in percent)



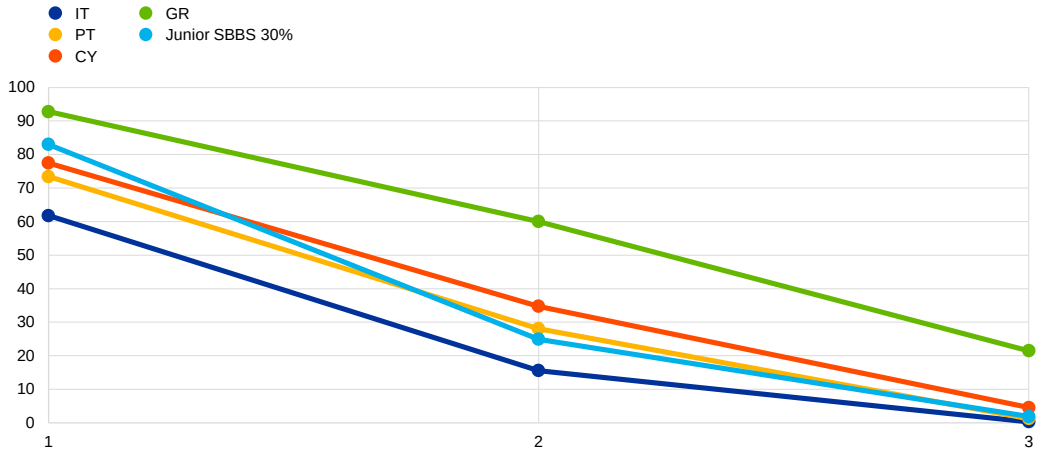
Source: ESRB calculations.

Note: The figure plots histograms of losses for national sovereign bonds in the benchmark calibration of the simulation model of Brunnermeier et al (2017). By design, the loss rate can only take four different values for each Member State: 0% (in the event of no default), the LGD in state 1 (in the event of default in a severe recession), the LGD in state 2 (in the event of default in a mild recession) or the LGD in state 3 (in the event of default in a period of expansion).

Figure 1.12

EL rates conditional on the aggregate state of the euro area economy (adverse model calibration)

(in percent)

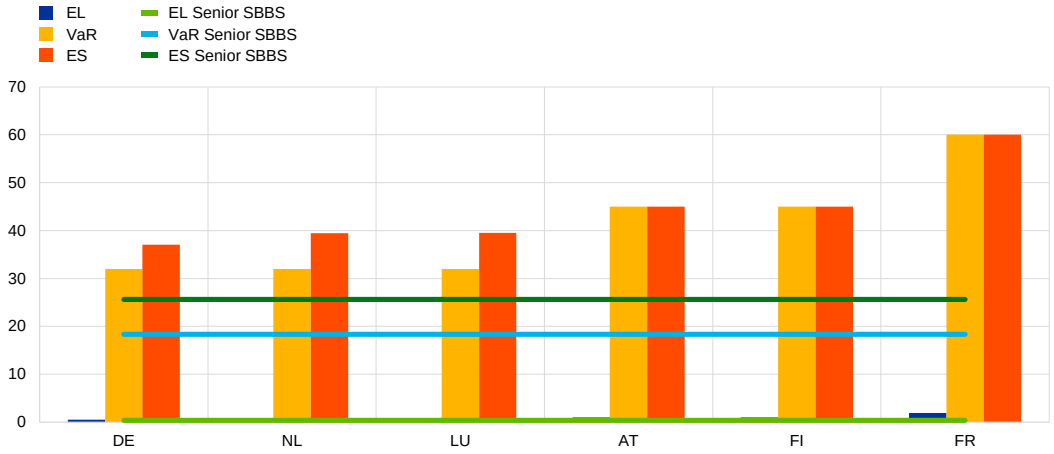


Source: ESRB calculations.
Note: The figure reports the CEL rates of junior SBBS compared with those of four national sovereign bonds (i.e. Italy, Portugal, Cyprus and Greece) depending on the aggregate state of the euro area economy in a given draw of the adverse calibration of the simulation model of Brunnermeier et al (2017). State 1 is characterised by severe recession; state 2 describes a mild recession; and state 3 represents macroeconomic expansion.

Figure 1.13

Risk measures for senior SBBS and national sovereign bonds (adverse model calibration; VaR and ES at 1% level)

(in percent)

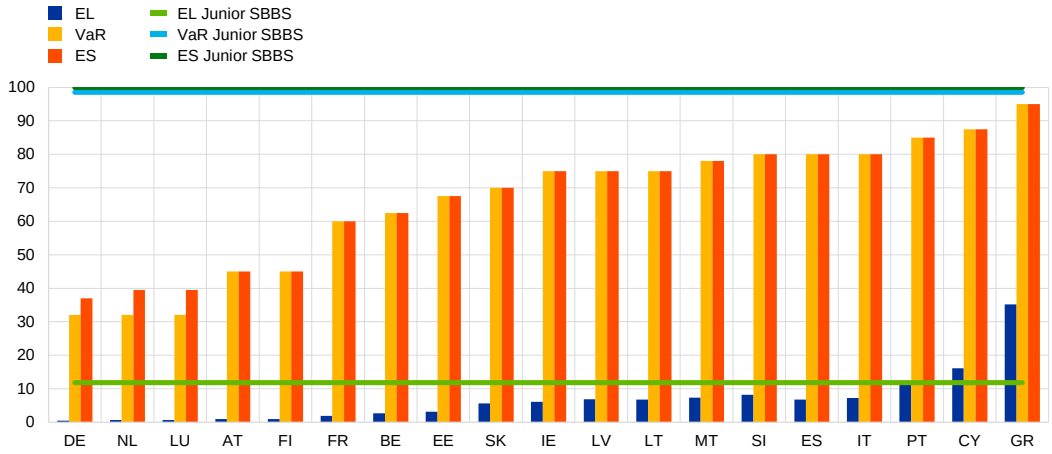


Source: ESRB calculations.
Note: The figure plots the EL, 1% VaR and 1% ES for senior SBBS and national sovereign bonds in the adverse calibration of the simulation model of Brunnermeier et al (2017). EL rates are barely visible due to scaling.

Figure 1.14

Risk measures for junior SBBS and national sovereign bonds (adverse model calibration; VaR and ES at 1% level)

(in percent)



Source: ESRB calculations.

Note: The figure plots the EL, 1% VaR and 1% ES for junior SBBS and national sovereign bonds in the benchmark calibration of the simulation model of Brunnermeier et al (2017).

Table 1.9

Risk measures for SBBS and national sovereign bonds (benchmark model calibration)

(in percent)

	EL	CEL (state 1)	CEL (state 2)	CEL (state 3)	VaR (5%)	VaR (4%)	VaR (3%)	VaR (2%)	VaR (1%)	ES (5%)	ES (4%)	ES (3%)	ES (2%)	ES (1%)
Senior SBBS (70%)	0.09	1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.75	2.19	2.91	4.37	8.74
Junior SBBS (30%)	9.10	72.00	17.14	1.71	46.61	58.67	66.82	86.32	98.52	76.71	82.74	89.36	95.89	99.91
… Mezzanine (20%)	3.80	60.28	3.89	0.00	19.92	38.01	50.23	79.48	97.79	65.07	74.12	84.04	93.83	99.87
… Junior (10%)	19.70	95.44	43.64	5.14	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Senior SBBS (80%)	0.33	7.09	0.03	0.00	0.00	0.00	0.06	7.37	11.95	6.64	8.29	11.06	14.78	20.12
Junior SBBS (20%)	12.63	86.36	25.58	2.57	69.92	88.01	100.00	100.00	100.00	94.65	98.59	100.00	100.00	100.00
… Mezzanine (10%)	5.56	77.28	7.51	0.00	39.84	76.01	100.00	100.00	100.00	89.29	97.18	100.00	100.00	100.00
… Junior (10%)	19.70	95.44	43.64	5.14	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Germany	0.13	2.02	0.16	0.00	0.00	0.00	0.00	0.00	0.00	2.69	3.37	4.49	6.74	13.47
Netherlands	0.27	4.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	5.38	6.72	8.96	13.44	26.88
Luxembourg	0.27	3.99	0.32	0.00	0.00	0.00	0.00	0.00	0.00	5.36	6.70	8.93	13.39	26.78
Austria	0.50	6.73	0.72	0.00	0.00	0.00	0.00	0.00	36.00	10.03	12.54	16.72	25.09	42.12
Finland	0.50	6.75	0.72	0.00	0.00	0.00	0.00	0.00	36.00	10.04	12.55	16.73	25.10	42.14
France	1.09	15.02	1.45	0.01	0.00	0.00	0.00	0.00	60.00	21.72	27.16	36.21	54.31	60.00
Belgium	1.42	18.74	2.00	0.03	0.00	0.00	0.00	50.00	62.50	28.34	35.43	47.23	58.53	62.50
Estonia	1.83	23.58	2.70	0.03	0.00	0.00	33.75	54.00	67.50	36.61	45.76	60.81	64.73	67.50
Slovakia	2.05	24.46	3.37	0.04	0.00	0.00	56.00	56.00	70.00	41.05	51.32	63.42	67.13	70.00
Ireland	2.38	30.04	3.60	0.04	0.00	0.00	60.00	60.00	75.00	47.50	59.38	69.11	73.67	75.00
Latvia	3.42	37.56	6.02	0.11	60.00	60.00	60.00	75.00	75.00	66.84	68.55	71.39	75.00	75.00
Lithuania	3.41	37.40	6.00	0.11	37.50	60.00	60.00	75.00	75.00	66.73	68.51	71.34	75.00	75.00

	EL	CEL (state 1)	CEL (state 2)	CEL (state 3)	VaR (5%)	VaR (4%)	VaR (3%)	VaR (2%)	VaR (1%)	ES (5%)	ES (4%)	ES (3%)	ES (2%)	ES (1%)
Malta	3.92	42.86	6.86	0.16	62.40	62.40	62.40	78.00	78.00	70.20	72.15	75.40	78.00	78.00
Slovenia	4.90	47.93	9.60	0.16	64.00	64.00	64.00	80.00	80.00	72.72	74.91	78.54	80.00	80.00
Spain	4.90	48.02	9.59	0.16	64.00	64.00	64.00	80.00	80.00	72.74	74.92	78.57	80.00	80.00
Italy	5.63	51.93	11.53	0.20	64.00	64.00	64.00	80.00	80.00	73.45	75.81	79.75	80.00	80.00
Portugal	8.97	59.49	20.38	1.06	68.00	68.00	85.00	85.00	85.00	78.83	81.53	85.00	85.00	85.00
Cyprus	13.58	65.56	28.02	4.38	70.00	70.00	87.50	87.50	87.50	81.93	84.92	87.50	87.50	87.50
Greece	34.16	90.19	56.95	21.37	76.00	95.00	95.00	95.00	95.00	92.41	95.00	95.00	95.00	95.00

Source: ESRB calculations.
Note: The table reports risk measures for SBBS and national sovereign bonds under the benchmark calibration of the simulation model of Brunnermeier et al (2017). In addition to EL rates, the table shows CEL, VaR and ES at different risk thresholds.

Table 1.10

Risk measures for SBBS and national sovereign bonds (adverse model calibration)

(in percent)

	EL	CEL (state 1)	CEL (state 2)	CEL (state 3)	VaR (5%)	VaR (4%)	VaR (3%)	VaR (2%)	VaR (1%)	ES (5%)	ES (4%)	ES (3%)	ES (2%)	ES (1%)
Senior SBBS (70%)	0.42	7.73	0.26	0.00	0.00	0.00	1.38	5.88	18.37	8.46	10.57	14.00	19.37	25.66
Junior SBBS (30%)	11.81	83.01	24.89	1.87	80.81	94.55	100.00	100.00	100.00	97.39	99.65	100.00	100.00	100.00
... Mezzanine (20%)	7.60	76.80	14.84	0.11	71.21	91.83	100.00	100.00	100.00	96.09	99.48	100.00	100.00	100.00
... Junior (10%)	20.24	95.44	45.00	5.39	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Senior SBBS (80%)	1.02	15.27	1.18	0.00	5.30	10.46	13.71	17.65	28.57	18.92	21.62	24.75	29.45	34.95
Junior SBBS (20%)	15.13	90.48	33.53	2.80	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
... Mezzanine (10%)	10.03	85.52	22.06	0.22	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
... Junior (10%)	20.24	95.44	45.00	5.39	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Germany	0.50	5.52	0.90	0.01	0.00	0.00	0.00	0.00	32.00	10.06	12.58	16.77	25.15	37.02
Netherlands	0.69	8.20	1.14	0.01	0.00	0.00	0.00	0.00	32.00	13.81	17.27	23.02	34.53	39.46
Luxembourg	0.69	8.24	1.14	0.01	0.00	0.00	0.00	0.00	32.00	13.83	17.29	23.05	34.58	39.50
Austria	0.96	11.22	1.63	0.01	0.00	0.00	0.00	36.00	45.00	19.26	24.07	32.09	41.11	45.00
Finland	0.96	11.21	1.64	0.01	0.00	0.00	0.00	36.00	45.00	19.28	24.10	32.13	41.10	45.00
France	1.94	21.92	3.34	0.05	0.00	0.00	48.00	48.00	60.00	38.74	48.43	54.65	57.97	60.00
Belgium	2.64	29.48	4.59	0.07	0.00	50.00	50.00	62.50	62.50	52.73	56.71	58.94	62.50	62.50
Estonia	3.10	34.38	5.48	0.08	54.00	54.00	54.00	67.50	67.50	60.26	61.82	64.43	67.50	67.50
Slovakia	5.58	49.24	11.82	0.19	56.00	56.00	70.00	70.00	70.00	64.96	67.20	70.00	70.00	70.00
Ireland	6.05	54.52	12.63	0.21	60.00	60.00	75.00	75.00	75.00	69.92	72.40	75.00	75.00	75.00
Latvia	6.81	58.00	14.67	0.27	60.00	60.00	75.00	75.00	75.00	70.56	73.19	75.00	75.00	75.00
Lithuania	6.80	57.85	14.65	0.28	60.00	60.00	75.00	75.00	75.00	70.53	73.16	75.00	75.00	75.00

	EL	CEL (state 1)	CEL (state 2)	CEL (state 3)	VaR (5%)	VaR (4%)	VaR (3%)	VaR (2%)	VaR (1%)	ES (5%)	ES (4%)	ES (3%)	ES (2%)	ES (1%)
Malta	7.32	62.00	15.75	0.33	62.40	62.40	78.00	78.00	78.00	73.68	76.51	78.00	78.00	78.00
Slovenia	8.17	65.38	18.31	0.33	64.00	64.00	80.00	80.00	80.00	75.90	78.87	80.00	80.00	80.00
Spain	6.80	59.69	14.42	0.25	64.00	64.00	80.00	80.00	80.00	74.86	77.58	80.00	80.00	80.00
Italy	7.22	61.77	15.57	0.27	64.00	64.00	80.00	80.00	80.00	75.24	78.05	80.00	80.00	80.00
Portugal	11.80	73.39	28.04	1.24	68.00	68.00	85.00	85.00	85.00	81.36	84.70	85.00	85.00	85.00
Cyprus	16.07	77.48	34.75	4.55	70.00	87.50	87.50	87.50	87.50	84.10	87.50	87.50	87.50	87.50
Greece	35.19	92.80	60.00	21.49	76.00	95.00	95.00	95.00	95.00	92.89	95.00	95.00	95.00	95.00

Source: ESRB calculations.
Note: The table reports risk measures for SBBS and national sovereign bonds under the adverse calibration of the simulation model of Brunnermeier et al (2017). In addition to EL rates, the table shows CEL, VaR and ES at different risk thresholds.

1.4 Estimating yields on SBBS

This section generates estimates for the yields on SBBS by implementing a pricing tool using historical market data and a correlated multivariate Monte Carlo approach. This sheds light on the likely behaviour of the different securities at different maturities during recent financial history, which includes the euro area sovereign debt crisis. This allows the real-time consequences of changes in default expectations to be assessed and compared. This is important because, during crisis periods, adverse price movements can generate self-fulfilling crisis dynamics (spikes in holding-period risks tend to push up the cost of funding and this might be perceived as unsustainable). Flight-to-safety plays a role in these adverse yield movements and it is of interest to examine how SBBS could matter for such dynamics. The behaviour of SBBS with different maturities and the calculation of established risk measures are also studied.

It should be noted that any estimate of SBBS yields is affected by model uncertainty for at least two reasons: (1) in the literature, there are many different approaches to modelling the default risk of defaultable assets; (2) euro area government bond yields can be affected by redenomination risks, especially in periods of high volatility. For this reason, this report carries out simulations under many different hypotheses and for a variety of risk measures to gauge the range of possible outcomes and establish the robustness of point estimates.

In the standard 70-20-10 seniority structure, SBBS consist of:

- a junior security, taking the first 10% of losses;
- a mezzanine security, taking losses from 10% to 30%;
- a senior security, exposed only to losses above 30%.

1.4.1 Methodology

This section provides an estimate of the yield on the three securities based on a multivariate Monte Carlo simulation, using the static copula approach described in Schönbucher (2003). A joint distribution function of country-specific random variables is estimated to derive scenarios in which the individual country may default. The joint distribution function is created with a Gaussian copula;[13] it is thereby transformed into country-specific variables that are correlated and can take values between zero and one. Depending on the actual historical PD of the country in question, the country defaults if the value of its random variable (i.e. one scenario within the simulation run per day and country) exceeds the threshold of (1-PD). For example, random values above 0.96 lead to a default for a country with a PD of 4%.

[13] For robustness, Table 1.12 shows the main results when using a t-copula with different degrees of freedom instead of a Gaussian copula.

In this way, the scenarios define which sovereign bonds in the SBBS structure default and allow the associated loss to be calculated. The losses are assigned to the different securities according to their seniority, enabling EL distributions to be constructed. The overall risk premium (yield exceeding the risk-free rate) of the bond portfolio is then allocated to the securities according to their EL. Consistency checks ensure that the weighted average yield on the securities is identical to the yield on the underlying bond portfolio.

The estimation is based on historical market data. The difference between the sovereign bond yields of the respective day and the risk-free rate is taken as an estimate for the ELs of the individual sovereigns. The EL allows inference on PD values by assuming an LGD of 100%.[14] Risk aversion affects the premium demanded by investors and might result in compensation in excess of the risk present. The implied risk premium (i.e. yield above the risk-free rate) reflects the risk aversion of the representative investor as well as the perceived level of credit risk on any given day and may therefore exceed the EL anticipated by a risk-neutral investor. Estimated yields on senior, mezzanine and junior SBBS consistently reflect the degree of risk aversion, which is taken into account in the simulation.

Thomson Reuters benchmark government indexes are used for the yield time series of the respective governments. Furthermore, for the sake of simplicity, the lowest sovereign bond yield is used as the risk-free rate of the respective day. The country correlation in the default scenario generator is set at a constant value of 60%. This value is applied uniformly to all bilateral correlations between the country-specific random variables. This quite conservative assumption means that the random variables determining default events are noticeably interdependent, incorporating strong contagion effects.[15] 30,000 scenarios per day and country have been used for the simulation. The R package MASS generated (uniform) correlated default scenarios. For reasons of data availability, the simulation is based on yield data for two-, five- and 10-year government bonds of Austria, Belgium, Germany, Spain, Finland,[16] France, Greece,[17] Ireland,[18] Italy, the Netherlands and Portugal, following a weighting scheme based on GDP (averaged over 2006-15). This basket covers approximately 97.5% of the SBBS volume.

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[14] The implied PD assumes an LGD of 100%. With the default correlation assumption of 60%, the yield is no longer fully independent of the division of EL into PD and LGD. The yields start to diverge slightly for LGD values above 60%. For instance, on the basis of a 70-30 seniority structure and a default correlation assumption of 60%, the yields on junior SBBS for LGD values of 30%, 60% and 100% are 2.63%, 2.61% and 2.52% respectively (as at 31 October 2016), while the yields on senior SBBS are 0.08%, 0.09% and 0.13% respectively. An LGD of 100% is used in order not to understate the yield and resulting EL of senior SBBS (compared with the German sovereign bond) and not to overstate the attractiveness of junior SBBS, also given that 100% LGD forms a natural upper bound on projected losses.

[15] Note that the different PDs of the respective countries also influence the occurrence of default events. Even in the case of 100% correlation, the random variable would have to surpass a different PD threshold for, say, Germany than for Portugal. Also note that a robustness check was performed, for the default correlation assumption that is shown in Table 1.11.

[16] Only included in the five and 10 year simulations due to data availability.

[17] Only included in the 10 year simulation due to data availability.

[18] Only included in the five and 10 year simulations due to data availability.

1.4.2 Results

Results for the 10-year maturity

Table 1.11 summarises the results for yields on 10-year senior, mezzanine and junior securities (as at 31 October 2016). Depending on the seniority structure chosen, the senior security yield lies between 0.13% and 0.4%. If a seniority structure with three components is used, the mezzanine would have a yield of between 1.4% (if its subordination level ranges from 10% to 30%, corresponding to the standard 70-20-10 seniority structure) and 2.1% (if it has a subordination level ranging from 10% to 20%, corresponding to an 80-10-10 seniority structure). 10%-thick junior SBBS would reach yields of up to 4.9%.

Table 1.11
10-year SBBS yields with different seniority structures and a 60% default correlation

(as at 31 October 2016)

Seniority structure (senior-mezz-junior)	Senior	Mezzanine	Junior	Weighted pool
70-20-10	0.13%	1.35%	4.88%	0.85%
80-10-10	0.19%	2.07%	4.88%	0.85%
70-0-30	0.13%	-	2.52%	0.85%
80-0-20	0.19%	-	3.48%	0.85%
90-0-10	0.40%	-	4.88%	0.85%

Source: ESRB calculations.
Note: The table reports 10-year SBBS yields with different seniority structures under the assumption of 60% default correlation. The standard seniority structure of 70-20-10 is given in the first row of the table.

The yield on the underlying pool of government bonds is distributed across the junior, mezzanine and senior SBBS according to their respective risk. Once a realised loss exceeds the thickness of junior SBBS (i.e. the most subordinated or the least senior security), any additional loss is covered by the mezzanine and senior securities.

Results are generally stable, but are somewhat sensitive to the assumed correlation of default. If the default correlation between countries increases, more extreme events become increasingly likely. Consequently, higher correlation implies that greater risk is borne by mezzanine and senior SBBS. Their share of the yield available from the pool of underlying government bonds therefore increases at the expense of junior SBBS. As a corollary, the yield on junior SBBS decreases with increased correlation, and gradually converges with the yield on the other securities. Table 1.12 quantifies yields on 10-year SBBS according to uniform default correlation assumptions, in addition to the estimation error (one standard deviation) for the yield estimates.

The simulations start from the fact that PDs differ across countries. These differing country PDs limit the extent of default correlation, which must be take into account when making modelling choices. When the simulation is run, a random number is drawn for each country, which determines whether a country defaults. In particular, if the number exceeds the threshold set by the respective

country PD. These default triggers can be correlated, possibly up to 100%. This set-up combines varying PDs across countries with perfect correlation in the default triggers. If all country PDs are artificially set at the same level (at each point in time), SBBS yields fully converge in the limiting case of 100% default correlation.

Table 1.12

Yield on 10-year SBBS with the standard 70-20-10 seniority structure according to the assumed underlying default correlation

(as at 31 October 2016)

	Yield per annum			Estimation error		
Default correlation	Senior (70%-thick)	Mezz (20%-thick)	Junior (10%-thick)	Error (senior)	Error (mezz)	Error (junior)
5%	0.08%	0.97%	5.96%	0.00%	0.00%	0.11%
10%	0.08%	1.01%	5.87%	0.00%	0.00%	0.11%
20%	0.09%	1.05%	5.79%	0.00%	0.00%	0.11%
30%	0.09%	1.14%	5.55%	0.00%	0.00%	0.10%
40%	0.10%	1.21%	5.39%	0.00%	0.00%	0.10%
50%	0.12%	1.26%	5.15%	0.01%	0.00%	0.10%
60%	0.13%	1.35%	4.88%	0.01%	0.00%	0.10%
70%	0.16%	1.38%	4.56%	0.01%	0.00%	0.10%
80%	0.21%	1.44%	4.12%	0.01%	0.00%	0.09%
90%	0.24%	1.44%	3.93%	0.01%	0.00%	0.09%
100%	0.30%	1.45%	3.51%	0.02%	0.00%	0.08%

Source: ESRB calculations.
Note: The table reports yields on 10-year SBBS with the 70-20-10 seniority structure according to the assumed underlying default correlation. In the simulations, the benchmark default correlation that is assumed is 60%.

As a robustness check, the estimations are derived by using a t-copula instead of the Gaussian copula. Table 1.13 shows the main results for a default correlation of 60%. As can be seen, these results depend on the degrees of freedom assumed. The higher the degrees of freedom, the more the results converge with those of the Gaussian copula, implying lower senior yields and higher junior yields. Overall, however, this robustness check confirms that the results are robust. The effect of changing the degrees of freedom from five to 100,000,000 has a similar effect to increasing the default correlation from 60% to 70%.

Table 1.13

10-year SBBS yields estimated by t-copula according to the assumed degrees of freedom

(as at 31 October 2016)

Degrees of freedom	Senior (70%-thick)	Mezz (20%-thick)	Junior (10%-thick)	Error (senior)	Error (mezz)	Error (junior)
5	0.17%	1.39%	4.50%	0.01%	0.06%	0.10%
10	0.16%	1.35%	4.65%	0.01%	0.05%	0.10%
100	0.13%	1.33%	4.90%	0.01%	0.05%	0.10%
1,000	0.13%	1.30%	5.00%	0.01%	0.05%	0.10%
10,000	0.14%	1.33%	4.86%	0.01%	0.05%	0.10%
1,000,000	0.13%	1.36%	4.85%	0.01%	0.05%	0.10%
100,000,000	0.14%	1.34%	4.86%	0.01%	0.05%	0.10%

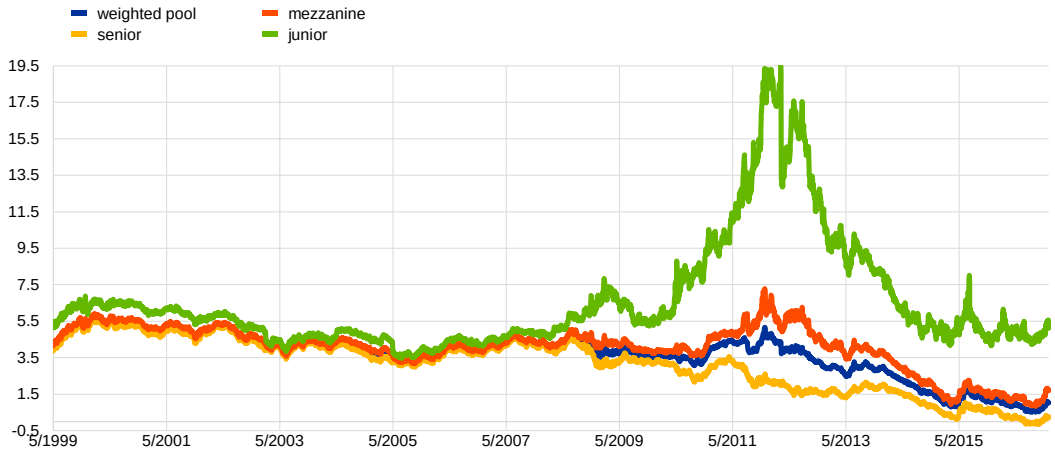
Source: ESRB calculations.
Note: The table reports yields on 10-year SBBS estimated by t-copula according to the assumed degrees of freedom. In the limit, with ever more degrees of freedom, yields estimated by t-copula converge to those estimated by Gaussian copula.

Figure 1.15 shows the time series of estimated yields on SBBS for the 70-20-10 seniority structure. Senior, mezzanine and junior SBBS have similar yields during calm market conditions. However, they start to diverge in 2008. Junior SBBS have the most risk and therefore require more yield, with highs of around 19.5% in 2011-12. Yields on mezzanine SBBS exceed the senior security by up to 5% at the height of the crisis, which is slightly less than yields on Italian government bonds.

Figure 1.15

Yields on 10-year SBBS based on bond-implied PDs, historical market data and a default correlation of 60% (for the 70-20-10 seniority structure)

(in percent)



Source: ESRB calculations.
Note: The figure plots yields on 10-year SBBS for the 70-20-10 seniority structure.

Table 1.14 shows the average 60-day volatility of 10-year securities in the available time span from January 2000 to October 2016. The volatility of senior SBBS is similar to that of the lowest-risk national government bond in the euro area, namely the German sovereign bond. The volatility of mezzanine SBBS is below that of higher-risk government bonds, while the volatility of the junior security is higher. However, while these results on volatility are informative, they do not represent a sufficient measure of risk. Therefore, other risk measures are presented below.

Table 1.14

60-day volatility of daily yield changes for different seniority structures of 10-year SBBS (with 60% default correlation) and national sovereign bonds

(average over January 2000 to October 2016)

Seniority structure (senior-mezz-junior)	Senior	Mezz	Junior	Germany	Italy	Portugal	Greece
70-20-10	0.03%	0.04%	0.11%	0.04%	0.05%	0.08%	0.20%
80-10-10	0.03%	0.06%	0.11%	0.04%	0.05%	0.08%	0.20%
70-0-30	0.03%	-	0.05%	0.04%	0.05%	0.08%	0.20%
80-0-20	0.03%	-	0.07%	0.04%	0.05%	0.08%	0.20%
90-0-10	0.03%	-	0.11%	0.04%	0.05%	0.08%	0.20%

Source: ESRB calculations.
Note: The table reports the 60-day standard deviations of daily yield changes for 10-year SBBS and national sovereign bonds. Standard deviations are averaged over January 2000 to October 2016.

Common risk measures can be also analysed using the time series for SBBS yields resulting from the calibrated scenario generator. Table 1.15 shows the EL of the senior, mezzanine and junior securities in the various seniority structures and compares this with the EL rates of several national sovereign bonds. As this risk measure varies significantly over time, the historical averages in the period from January 2000 to October 2016 are plotted. In this long-term view, the yield and EL on 10-year senior SBBS in the 70-20-10 (and thus also 70-30) and 80-10-10 (and thus also 80-20) seniority structures are close to the respective levels of the German sovereign bond on average. The yield and the EL on 10-year mezzanine SBBS in both the 70-20-10 and 80-10-10 structures are below the respective levels of 10-year Portuguese government bonds. In the standard 70-20-10 structure, they are close to the yield and EL of 10-year Italian government bonds. By contrast, the yield and EL on 10%-thick, 10-year junior SBBS are above the Portuguese levels but considerably below the Greek levels.

Table 1.15

EL rates on 10-year SBBS and national sovereign bonds (full sample)

(average over January 2000 to October 2016)

Seniority structure (senior-mezz- junior)	Senior	Mezz	Junior	Weighted pool	Germany	France	Italy	Portugal	Greece
70-20-10	0.05%	0.98%	3.55%	0.59%	0.02%	0.29%	1.08%	2.00%	4.89%
80-10-10	0.11%	1.47%	3.55%	0.59%	0.02%	0.29%	1.08%	2.00%	4.89%
70-0-30	0.05%	-	1.84%	0.59%	0.02%	0.29%	1.08%	2.00%	4.89%
80-0-20	0.11%	-	2.51%	0.59%	0.02%	0.29%	1.08%	2.00%	4.89%
90-0-10	0.26%	-	3.55%	0.59%	0.02%	0.29%	1.08%	2.00%	4.89%

Source: ESRB calculations.
Note: The table reports expected loss rates on 10-year SBBS and national sovereign bonds averaged over January 2000 to October 2016.

To quantify the riskiness of SBBS in times of crisis, Table 1.16 shows average EL rates over 2011-12. During this period of elevated yields on national sovereign bonds, the EL on the 10-year senior security deviates only slightly from the yield on the German sovereign bond, regardless of whether it is 70%- or 80%-thick, and remains closer to it than any other national sovereign bond in the euro area. Also in parallel to the long-term average, the ELs on 10-year mezzanine SBBS in both the 70-20-10 and 80-10-10 seniority structures are considerably below the respective levels of 10-year Portuguese government bonds, and in the former case are close to the levels of 10-year Italian government bonds. Again, similar to their long-term averages, 10-year junior SBBS in both seniority structures have ELs that are considerably below the levels of Greek government bonds. SBBS would therefore have remained quite resilient during the crisis, with increases in national sovereign bond yields affecting the relative yields on SBBS.

Table 1.16

EL rates on 10-year SBBS and national sovereign bonds (crisis period)

(average over January 2011 to December 2012)

Seniority structure (senior-mezz-junior)	Senior	Mezz	Junior	Weighted pool	Germany	France	Italy	Portugal	Greece
70-20-10	0.18%	3.20%	11.79%	1.95%	0.00%	0.81%	3.29%	8.22%	19.78%
80-10-10	0.38%	4.66%	11.79%	1.95%	0.00%	0.81%	3.29%	8.22%	19.78%
70-0-30	0.18%	-	6.06%	1.95%	0.00%	0.81%	3.29%	8.22%	19.78%
80-0-20	0.38%	-	8.23%	1.95%	0.00%	0.81%	3.29%	8.22%	19.78%
90-0-10	0.85%	-	11.79%	1.95%	0.00%	0.81%	3.29%	8.22%	19.78%

Source: ESRB calculations.
Note: The table reports expected loss rates on 10-year SBBS and national sovereign bonds averaged over January 2011 to December 2012.

Table 1.17 shows the VaR at the 1% confidence level and the ES at the 1% confidence level for senior, mezzanine and junior securities in various seniority structures and compares them with the corresponding values of several national sovereign bonds. As reliable VaR figures for national sovereign bonds are available only for historical market VaR, this risk measure is shown based on the year-on-year changes in bond prices. Again, these risk measures for the 10-year senior security in both the 70-20-10 and 80-10-10 seniority structures are close to the respective levels of the German sovereign bond on average. Also, the 1% VaR and 1% ES for 10-year mezzanine SBBS in the standard 70-20-10 seniority structure are close to the levels of 10-year Italian government bonds.

Table 1.17

1% VaR and 1% ES of 10-year SBBS and national sovereign bonds (full sample)

(average over April 2000 to October 2016)

Seniority structure (senior-mezz-junior)	Senior	Mezz	Junior	Weighted pool	Germany	France	Italy	Portugal	Greece
70-20-10 (1% VaR)	-7.9%	-14.2%	-37.9%	-9.3%	-7.6%	-9.0%	-13.1%	-35.9%	-73.7%
70-20-10 (1% ES)	-10.2%	-16.6%	-39.2%	-10.2%	-10.0%	-11.0%	-15.1%	-39.0%	-76.4%
80-10-10 (1% VaR)	-7.9%	-20.2%	-37.9%	-9.3%	-7.6%	-9.0%	-13.1%	-35.9%	-73.7%
80-10-10 (1% ES)	-10.2%	-22.6%	-39.2%	-10.2%	-10.0%	-11.0%	-15.1%	-39.0%	-76.4%
70-0-30 (1% VaR)	-7.9%	-	-24.8%	-9.3%	-7.6%	-9.0%	-13.1%	-35.9%	-73.7%
70-0-30 (1% ES)	-10.2%	-	-26.5%	-10.2%	-10.0%	-11.0%	-15.1%	-39.0%	-76.4%
80-0-20 (1% VaR)	-7.9%	-	-30.7%	-9.3%	-7.6%	-9.0%	-13.1%	-35.9%	-73.7%
80-0-20 (1% ES)	-10.2%	-	-32.3%	-10.2%	-10.0%	-11.0%	-15.1%	-39.0%	-76.4%
90-0-10 (1% VaR)	-7.9%	-	-37.9%	-9.3%	-7.6%	-9.0%	-13.1%	-35.9%	-73.7%
90-0-10 (1% ES)	-10.2%	-	-39.2%	-10.2%	-10.0%	-11.0%	-15.1%	-39.0%	-76.4%

Source: ESRB calculations.
Note: The table reports historical market risk of 10-year SBBS and national sovereign bonds measured by 1% VaR and 1% ES.

Table 1.18 reports a robustness check for the resilience of SBBS during periods of financial stress. In 2011 and 2012, the 1% VaR and 1% ES of the 10-year senior security in both the 70-20-10 and 80-10-10 structures deviate from the respective levels of the German sovereign bond and are close to the levels of 10-year government bonds of France, Austria and the Netherlands. Like the long-term average, the 1% VaR and 1% ES of 10-year mezzanine SBBS in both the 70-20-10 and 80-10-10 structures are considerably below the respective levels of 10-year Portuguese government bonds and, in the standard 70-20-10 case, are close to the levels of 10-year Italian government bonds. Again, similar to the long-term average, the 1% VaR and 1% ES of 10%-thick, 10-year junior SBBS are close to the Portuguese levels.

Table 1.18

1% VaR and 1% ES of 10-year SBBS and national sovereign bonds (crisis period)

(average over January 2011 to December 2012)

Seniority structure (senior-mezz-junior)	Senior	Mezz	Junior	Weighted pool	Germany	France	Italy	Portugal	Greece
70-20-10 (1% VaR)	-4.1%	-18.9%	-40.1%	-9.2%	-2.4%	-3.8%	-17.1%	-41.3%	-78.2%
70-20-10 (1% ES)	-4.3%	-19.9%	-40.7%	-9.6%	-2.7%	-4.1%	-18.0%	-43.6%	-78.6%
80-10-10 (1% VaR)	-4.3%	-25.2%	-40.1%	-9.2%	-2.4%	-3.8%	-17.1%	-41.3%	-78.2%
80-10-10 (1% ES)	-4.5%	-26.2%	-40.7%	-9.6%	-2.7%	-4.1%	-18.0%	-43.6%	-78.6%
70-0-30 (1% VaR)	-4.1%	-	-28.3%	-9.2%	-2.4%	-3.8%	-17.1%	-41.3%	-78.2%
70-0-30 (1% ES)	-4.3%	-	-29.2%	-9.6%	-2.7%	-4.1%	-18.0%	-43.6%	-78.6%
80-0-20 (1% VaR)	-4.3%	-	-33.9%	-9.2%	-2.4%	-3.8%	-17.1%	-41.3%	-78.2%
80-0-20 (1% ES)	-4.5%	-	-34.8%	-9.6%	-2.7%	-4.1%	-18.0%	-43.6%	-78.6%
90-0-10 (1% VaR)	-4.8%	-	-40.1%	-9.2%	-2.4%	-3.8%	-17.1%	-41.3%	-78.2%
90-0-10 (1% ES)	-5.1%	-	-40.7%	-9.6%	-2.7%	-4.1%	-18.0%	-43.6%	-78.6%

Source: ESRB calculations.
Note: The table refers to the historical market risk measured by 1% VaR and 1% ES of 10-year SBBS and national sovereign bonds.

Comparison of results for two-, five- and 10-year maturities

In addition to the results for the 10-year maturity point, yields for two- and five-year SBBS are also calculated. They are reported in Tables 1.19 and 1.20, and yields on national sovereign bonds on 31 October 2016 are reported in Table 1.21 for comparison. Figure 1.16 plots the yield curve for the standard 70-20-10 seniority structure as at 31 October 2016.

Estimated yields on two- and five-year senior SBBS are negative (as at 31 October 2016). This is not surprising, as most of the single-country government bonds that constitute the underlying portfolio also have negative yields. Mezzanine SBBS at the five- and two-year maturities provide positive yields for the 80-10-10 structure (i.e. 0.6% and 0.13% respectively), but turn slightly negative (at -0.20% for the two-year yield) for the 70-20-10 seniority structure. Yields on junior SBBS reach 1.62% (at the five-year maturity point) and 0.71% (for the two-year).

Table 1.19

Five-year SBBS yields with different seniority structures and 60% default correlation

(as at 31 October 2016)

Seniority structure (senior-mezz-junior)	Senior	Mezzanine	Junior	Weighted pool
70-20-10	-0.43%	0.22%	1.62%	-0.09%
80-10-10	-0.39%	0.60%	1.62%	-0.09%
70-0-30	-0.43%	-	0.69%	-0.09%
80-0-20	-0.39%	-	1.11%	-0.09%
90-0-10	-0.28%	-	1.62%	-0.09%

Source: ESRB calculations.
Note: The table reports five-year SBBS yields as at 31 October 2016 for different seniority structures and under the assumption of 60% default correlation.

Table 1.20

Two-year SBBS yields with different seniority structures and 60% default correlation

(as at 31 October 2016)

Seniority structure (senior-mezz-junior)	Senior	Mezzanine	Junior	Weighted pool
70-20-10	-0.63%	-0.20%	0.71%	-0.41%
80-10-10	-0.62%	0.13%	0.71%	-0.41%
70-0-30	-0.63%	-	0.10%	-0.41%
80-0-20	-0.62%	-	0.42%	-0.41%
90-0-10	-0.53%	-	0.71%	-0.41%

Source: ESRB calculations.
Note: The table reports two-year SBBS yields as at 31 October 2016 under different seniority structures under the assumption of a 60% default correlation.

Table 1.21

Yields on benchmark national sovereign bonds in the euro area

(as at 31 October 2016)

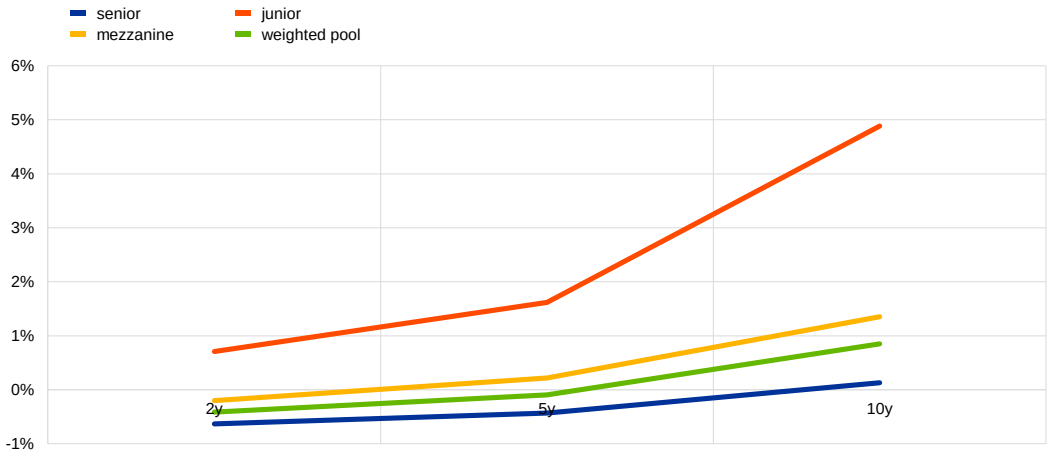
	Two-year	Five-year	10-year
Austria	-0.58%	-0.32%	0.35%
Belgium	-0.62%	-0.31%	0.42%
Germany	-0.64%	-0.45%	0.08%
Spain	-0.15%	0.18%	1.20%
Finland	-	-0.34%	0.30%
France	-0.58%	-0.25%	0.42%
Greece	-	-	8.33%
Ireland	-	-0.28%	0.65%
Italy	0.08%	0.56%	1.69%
Netherlands	-0.61%	-0.39%	0.28%
Portugal	0.41%	1.87%	3.33%

Source: Thomson Reuters.
Note: The table shows the yields on benchmark two-, five- and 10-year government bonds (as at 31 October 2016).

Figure 1.16

Yield curve of SBBS with the standard 70-20-10 structure and 60% default correlation

(as at 31 October 2016)



Source: ESRB calculations.
Note: The figure plots the yield curve of senior, junior and mezzanine SBBS (as at 31 October 2016) with the standard 70-20-10 seniority structure and assuming 60% default correlation.

1.4.3 Conclusion

This section provides yield estimates for different securities. In the standard 70-20-10 seniority structure, 70%-thick senior SBBS are estimated to have had a 10-year yield of 0.13% on 31 October 2016. The corresponding yield on 10-year 20%-thick mezzanine SBBS is estimated at 1.4%, and that on 10%-thick junior SBBS at 4.9%.[19] The yield on senior SBBS is similar to the lowest yields on euro area national government bonds, as the lowest national bond yield stood at 0.08% (i.e. the German sovereign bond) and the second lowest at 0.28% (the Dutch government bond) on that day. The yield on mezzanine SBBS is estimated to have been below the yield on Italian government bonds (1.7%) at the end of October 2016, while the yield on junior SBBS would have been above the yield on Portuguese government bonds (3.3%) but below that on Greek government bonds (8.3%).

From January 2000 to October 2016, the yield and EL on 10-year senior SBBS are estimated to have been close to the respective levels of the German sovereign bond. Also, the yield and EL on 10-year mezzanine SBBS in both the 70-20-10 and 80-10-10 seniority structures are below the respective levels of 10-year Portuguese government bonds and, in the 70-20-10 seniority structure, close to the levels of 10-year Italian government bonds. By contrast, the yield and EL on 10-year junior SBBS in both seniority structures are above the Portuguese levels but considerably below the Greek levels. For 10-year senior SBBS in both the 70-20-10 and 80-10-10 seniority structures, other common risk measures such as 1% VaR and 1% ES are close to the respective levels of the German sovereign bond on average. The market risk levels of 10-year mezzanine SBBS in the standard 70-20-10 seniority structure are close to the levels of 10-year Italian government bonds, while the 1% VaR and 1% ES of 10-year junior SBBS are close to the Portuguese levels.

During 2011-12, the yield and EL on 10-year senior SBBS deviate only slightly from the respective levels of the German sovereign bond and remain closer to it than any other national sovereign bond in the euro area. Senior SBBS' 1% VaR and 1% ES in both the 70-20-10 and 80-10-10 seniority structures deviate from the respective levels of the German sovereign bond and are close to the respective levels of the 10-year government bonds of France, Austria and the Netherlands. The yield, EL, 1% VaR and 1% ES of the 10-year mezzanine SBBS in the standard 70-20-10 structure are close to the levels of 10-year Italian government bonds, in parallel to the long-term average. The 10-year junior SBBS have yield and EL values that exceed the respective levels of Portuguese government bonds but remain considerably below the levels of Greek government bonds. At the same time, the 1% VaR and 1% ES levels of junior SBBS are close to the Portuguese levels. In sum, according to the historical simulation, the SBBS structure remains quite resilient in times of crisis. Moreover, the evolution of SBBS yields and risk measures also indicate that financial fragmentation has abated, reflecting recent improvements to the euro area financial architecture and the fiscal positions of EU Member States, as well as favourable developments in the financial sector and real economy.

[19] In the 80-10-10 seniority structure, the yield on senior SBBS is slightly higher, at 0.19%, but still within the range of the two national bonds with the lowest yields in the euro area. The yields on mezzanine and junior SBBS are at more attractive levels, while still representing diversified, though leveraged, portfolios of national government bonds.

1.5 Dynamic risk assessment

The risk properties of SBBS have been assessed in terms of the likely losses that the different securities would suffer under simulated default scenarios. However, the analysis has not yet examined the effects of mark-to-market losses that may occur when there is rising uncertainty about possible defaults or when self-fulfilling destabilising dynamics are prevalent. This leaves a gap in our understanding of "flight-to-safety" effects and other types of market panic that could arise from concerns about the risk exposures of SBBS in extreme circumstances (and the feedback effects that such panic could generate).

There is a concern that investors in senior SBBS may be exposed to large mark-to-market valuation risks despite low ex post exposure to eventual defaults. This begs the question as to whether senior SBBS are likely to remain as low-risk as some single-name sovereign bonds, for example when the ELs on mezzanine and junior SBBS are at high levels. Similarly, there is a concern that there may be insufficient interest in holding junior SBBS given that their yield (when compared with some single-name sovereign bonds) may not be high enough to compensate for risk. It is of interest to compare the risk attributes of the proposed securities with those of a diversified portfolio of sovereign bonds to assess the properties that arise from contractual subordination rather than pure diversification effects.

The dynamic risk analysed in this section is therefore not exposure to default itself – as this has already been assessed in previous sections – but rather to a fall in the value of bond holdings over short periods (i.e., daily holding period return risks). These pricing risks are a function of changing expectations of default. Short-term shocks to market value are important as they affect the mark-to-market valuations of investors' portfolios and how investors respond in real time. This leads to knock-on effects such as higher haircuts when using the bonds for repo borrowing. But there are more subtle types of feedback effects that could arise. Since the volatility of short-term returns is clustered, a rise in volatility leads to a revision of expectations of future risk. This could prompt fire-sales into falling markets and exacerbate the initial price decline relative to what is warranted on the basis of fundamental default risk. This could affect sovereign ratings and lead to a shrinkage of the traditional investor base for sovereign debt. These value changes therefore have implications for the cost at which funding can be rolled-over. In extreme cases, elevated funding costs could lead to an unwarranted loss of market access.

The analysis in this section draws on literature on the measurement and assessment of tail risks and older literature on reward for risk. Important contributions to these strands of literature include Acharya et al (2012, 2017), Adrian and Brunnermeier (2016), Brownlees and Engle (2017), Engle and Manganelli (2004), Koenker and Bassett (1978), Scaillet (2005), Sharpe (1966, 1994), Shirvani and Wilbratte (2005), Silverman (1986) and White, Kim and Manganelli (2015).

This section presents results from a dynamic analysis of cross-asset risk relations, based on recent research by De Sola Perea, Dunne, Puhl and Reininger (2018). The "VAR-for-VaR" method of White, Kim and Manganelli (2015) and the MES approach of Brownlees and Engle (2017) are applied to estimated yields on SBBS (as described in Section 1.4) to assess ex ante exposures under various seniority structures. These risk assessments are compared with exposures to single-name sovereign bonds and a diversified portfolio.

VAR-for-VaR and MES are time-varying measures of tail risk and risk conditional on tail events in another asset. VAR-for-VaR measures the likelihood that extreme outcomes spill over from one asset to another. This methodology is applied to the bivariate relations between senior, mezzanine and junior SBBS. The analysis highlights how risks fluctuate in senior SBBS when defaults approach extreme levels in non-senior SBBS (i.e. when losses become more likely for investors in senior SBBS). MES, by contrast, reveals how one asset is expected to fare conditional on another asset experiencing a tail event. It can therefore capture flight-to-safety dynamics (i.e. positive outcomes for low-risk assets when other assets experience extremely negative outcomes). The MES analysis is applied to a pairing of senior and mezzanine SBBS (where the mezzanine security is regarded as the causal variable). In this way, the analysis quantifies the diversification and hedging properties of senior SBBS, which can then be compared with pairings of single-name low-risk/high-risk sovereign bonds or a diversified portfolio.

The analysis is extended to ascertain whether investors are adequately rewarded for the actual and expected risks of their holdings. A commonly used measure is the Sharpe ratio (Sharpe 1966, 1994). In an ex post sense, the Sharpe ratio captures the average excess holding period return relative to the historical standard deviation of such returns. It also measures expectations of excess returns relative to the conditional expected standard deviation of returns. GARCH-implied conditional standard deviation and projections of holding period excess returns are used to derive dynamic Sharpe ratios. Yield-to-maturity relative to conditional volatility (and relative to absolute VaR) of yield-to-maturity movements are also examined, in addition to the adequacy of holding period excess returns as a reward for risk. All reward for risk measures are compared for SBBS, a diversified portfolio of sovereign bonds and single-name sovereign bonds.

The main finding is that the estimated yield on senior SBBS has minor tail risk exposure and acts as a hedge against movements in the yields on junior SBBS. In the data, mezzanine SBBS have tail risk exposure similar to that of Italian and Spanish bonds. In terms of tail risk, junior SBBS are more exposed than Italian and Spanish bonds, but are similar to Irish and Portuguese bonds, and significantly less exposed than Greek bonds. Overall, yields on SBBS appear to provide adequate compensation for their risks when compared with single-name sovereign bonds or a diversified portfolio.

1.5.1 Background and data

The analysis focuses on a seniority structure with 70%-thick senior SBBS, 20%-thick mezzanine SBBS and 10%-thick junior SBBS. In unreported results, the analysis is also applied to the following seniority structures: 70-30, 80-20, 90-10 and 80-10-10. VAR-for-VaR and MES for the estimated yields are compared with the same measures for single-name sovereign bonds (from 11 euro area countries) and with a diversified portfolio of those bonds (weighted by GDP). The analysis is undertaken on assets with 10 years to maturity. The sample runs from the beginning of January 2003 to the end of October 2016. Daily data for individual sovereign bond yields are sourced from Thomson Reuters. Yields for the securities backed by these sovereign bonds are

estimated using the methodology discussed in Section 1.4. The negative of the daily yield change in basis points is used as the model variable.[20]

1.5.2 Comparing measured dynamic risks

Estimation results are presented graphically. Figures include the estimated 1% VaR and MES over time for the distribution of sign-reversed yield changes (i.e. minus the daily yield change measured in basis points). Comparisons are made between senior, junior and mezzanine SBBS, individual low-risk and high-risk sovereign bonds, and a GDP-weighted portfolio of euro area sovereign bonds. For a three-tier seniority structure, the VaR and MES analysis was first conducted for the mezzanine as a function of the junior component and then for all other variables as a function of extreme losses on mezzanine SBBS.

Figure 1.17 shows the case of the standard 70-20-10 seniority structure. This figure shows dot plots of the yield changes of mezzanine (light blue dots) and junior (light green dots) SBBS. The observations related to mezzanine SBBS are distributed with considerably smaller variance than observations on junior SBBS. Other variables shown in this figure include the 1% VaR for the mezzanine and junior SBBS (blue and dark blue lines respectively) and the MES of the mezzanine security (dark red line). The VaRs give a first indication of how volatility is concentrated within the junior security. During the most volatile periods, the VaR of the junior security goes below that of the mezzanine security by a factor of three. The MES of mezzanine SBBS, which is conditioned on the probability of junior SBBS having a yield change more negative than their 1% VaR, is often significantly above the mezzanine 1% VaR. This indicates that tail events in junior SBBS tend to coincide with less extreme (and often positive) movements in the mezzanine security (i.e. holders of the mezzanine security benefit from a degree of insurance due to initial losses being accepted by junior SBBS holders). This issue is analysed further in the case of the senior security, as discussed below.

Since junior SBBS generally have a very negative 1% VaR, it is insightful to compare it with VaRs of some of the higher-risk single-name sovereign bonds. Figure 1.18 shows the 1% VaR for 10%-thick junior SBBS compared with the 1% VaRs of three individual sovereign bonds that experienced high volatility during the sovereign debt crisis.

Junior SBBS' VaR is lower in absolute terms than the highest-risk sovereign VaR and quite often more benign than the Portuguese VaR. This reflects the benefits of diversification for even the most junior security. In the case of the Irish VaR, there is a period between the start of the Irish sovereign debt crisis (when guarantees given to depositors and senior bank bondholders imposed losses and recapitalisation costs on taxpayers) and the beginning of 2012 when risks were as great as, and occasionally greater than, that of junior SBBS. Outside of that period, the Irish VaR is practically indistinguishable from the VaR on mezzanine SBBS. The case of the Greek VaR is exceptional and even requires a change in the scale of the vertical axis on the figure. The VaR of junior SBBS is almost always less negative than the Greek VaR, and the latter often plunges

[20] A related analysis of the price returns has been conducted with similar results. In this case, the bond price is approximated as (100 – 10 (yield – coupon)).

several orders of magnitude below junior SBBS' VaR. This reflects the fact that the VaR of junior SBBS benefits from positive diversification effects.

Figure 1.19 shows the time series of risk measures of the German 10-year sovereign bond compared with senior and mezzanine SBBS in the standard 70-20-10 seniority structure. The mezzanine 1% VaR is shown as the light blue line. Senior SBBS and German 1% VaRs are shown as light green and purple lines respectively. These VaRs are almost indistinguishable from each other, implying that senior SBBS are just as low-risk as German government bonds on the basis of a VaR comparison. Senior SBBS and German bond MES measures are shown as dark blue and dark red lines respectively. (MES in this case is measured as the ES conditional on tail events in the mezzanine security exceeding the 1% VaR of that security – such losses can only occur after junior SBBS have been fully wiped out.) The MES profiles are similar, but when volatility is at its highest, the German MES slightly exceeds senior SBBS MES. This reflects the fact that German sovereign bonds historically benefited from a flight to safety effect.

It is worthwhile to consider how various single sovereign bonds and a diversified portfolio compare with the risk characteristics of the mezzanine and junior SBBS. Figure 1.20 shows VaR and MES risk measures for six lower-risk single-name sovereign bonds compared with the VaR for mezzanine SBBS in the standard 70-20-10 seniority structure. During volatile periods, these lower-risk sovereign bonds have 1% VaRs that remain relatively stable. In many cases, the whole distribution of returns on lower-risk sovereigns shifts upward. Moreover, the MES on these lower-risk sovereigns – that is, the shortfall conditional on negative outcomes for mezzanine SBBS below its 1% VaR – tends to rise significantly as the crisis intensifies and decline as it passes. This implies that there is a tendency towards positive returns for these lower-risk single-name sovereign bonds when there are extreme losses on mezzanine SBBS. This is particularly apparent in the case of the German, Finnish and Dutch sovereign bonds.

Figure 1.21 shows VaR and MES risk measures for Italian and Spanish sovereign bonds along with the euro area GDP-weighted portfolio. Each case includes the 1% VaRs for mezzanine and senior SBBS in the 70-20-10 seniority structure. The Italian and Spanish VaRs coincide almost exactly with mezzanine SBBS' VaR. The mezzanine security is comparable with the Italian and Spanish cases. The euro area portfolio has a VaR more in line with that of senior SBBS.

The country-specific MES comparisons in Figure 1.21 suggest that the shortfall conditional on mezzanine tail events is of a similar magnitude to the country-specific VaRs. Unlike for the low-risk sovereign bonds, this indicates that these higher-risk sovereign bonds are not benefiting from virtually any safe-haven status. For Italy and Spain, the MES and VaR produce similar results. The diversified portfolio has a MES which is close to its own VaR, despite being quite similar to other low-risk assets in terms of VaR. This implies that the portfolio provides risk reduction through diversification but does not act as a low-risk asset or hedge against tail risks.[21]

[21] Results for a 70-30 seniority structure have also been generated but are not reported here.

1.5.3 Measuring reward for risk

The above analysis considers only comparisons of tail risk exposure of SBBS. This section considers reward for such risks. Reward for risk is measured using conditional dynamic Sharpe ratios or closely related alternatives (for example, involving conditional standard deviation of yields rather than standard deviations of holding period returns, or relying on risk measured as VaR rather than as standard deviation).

A dynamic Sharpe ratio is constructed using a moving average of monthly returns divided by GARCH-implied conditional standard deviation. Yields-to-maturity relative to the conditional volatility of yield-to-maturity movements (and relative to VaR) are also assessed in addition to excess holding period returns. Sharpe values of SBBS (particularly junior SBBS) during the crisis are driven high by the fact that coupons (accrued interest) stay relatively static while the cost of an SBBS investment declines markedly (as yields rise due to the elevation in sovereign risk). Hence, the forward looking return (mainly the coupon) appears high relative to the cost of the investment and even relative to the standard deviation of the return.

Figure 1.22 shows the case of the monthly holding period Sharpe ratios for the senior, mezzanine and junior SBBS combined with the Sharpe ratios for the monthly holdings of German sovereign bonds (for the 10-year maturity bucket and 70-20-10 seniority structure). In each case, the coupon is allowed to have an upper and lower bound of one standard deviation around the chosen coupon rate (based on the standard error of the intercept coefficient in the regression of the coupon spread on yield spread). This reveals that Sharpe ratios are generally close together. All Sharpe ratios are low and declining during the global financial crisis until 2010. The financial crisis began to affect peripheral sovereign bonds during 2010. This seems to coincide with an increase in the Sharpe ratios for the senior and mezzanine SBBS and German sovereign bonds (perhaps reflecting flight-to-safety flows). Junior SBBS turn around later, and it is plausible that the ECB's interventions were responsible for reducing the risks associated with holding the higher risk sovereign bonds and therefore junior SBBS. Sharpe ratios tend to rise in early 2012 (with junior SBBS peaking far above the others at a value near nine), and then all but junior SBBS tend to stay around a value of four for the remainder of the sample, while the Sharpe ratio of junior SBBS declines to zero or below for the end of the sample.

The following analysis examines the compensation for risk where risk is measured as either GJR-GARCH conditional volatility or as VAR-for-VaR (these are therefore variations of the concept underlying the simple Sharpe ratio).[22] Figure 1.23 shows the dynamic relative reward for GJR-GARCH conditional volatility of individual sovereign bonds, the euro area portfolio, and senior, mezzanine and junior SBBS. The top panel considers the comparison for the group of low-risk sovereign bonds, while the bottom panel pertains to the relatively riskier sovereign bonds.

[22] This analysis is conducted without considering the fact that coupons could be distributed differently than is presumed under the estimation of SBBS historical yields. Since senior SBBS are as low-risk as the German sovereign bond it is likely that it would be rewarded with a similar coupon. This is less than what is paid on the pool of low-risk sovereign bonds, and gives rise to the prospect of paying additional coupons to junior SBBS. This would change the warranted yield-to-maturity of junior SBBS relative to what is assumed in SBBS yield estimations.

The time-varying Sharpe ratios in the top panel of Figure 1.23 indicate that senior SBBS are rewarded in a similar manner to German sovereign bonds. Both seem under-rewarded compared with other low-risk sovereign bonds, but this reflects the fact that they have substantial flight-to-safety price premia. The black dotted line represents the Sharpe ratio for senior SBBS in the top panel. This almost always lies directly over the German reading (shown in purple). There is some evidence of a difference between the German sovereign bond and senior SBBS during the pre-crisis period, when German bonds attracted a slightly higher return for risk, perhaps due to the fiscal position in Germany driving bond prices down slightly with little change in volatility. Overall, however, there is little difference between senior SBBS and the German bond in terms of their yield-to-maturity relative to GJR-GARCH volatility. This confirms the ranking of senior SBBS in the earlier analysis that was based purely on risk.

The time-varying Sharpe ratios in the bottom panel of Figure 1.23 reveal that junior SBBS are generally not well rewarded for volatility. This underperformance is more prominent in the pre-crisis period. During the crisis and post-crisis period, junior SBBS regularly enjoy a relatively high ranking in terms of reward for risk. As mentioned above, there is a possibility that junior SBBS receive extra coupons relative to what is assumed in the Monte Carlo analysis, which would make them more attractive to investors. In the absence of extra coupons, while junior SBBS do not appear to be well compensated, the reward for risk of the mezzanine security is in line with bonds issued by sovereigns such as Spain, Italy, Ireland and Portugal. Similar results obtain for the dynamic yield for absolute VaR earned by individual sovereign bonds, the euro area portfolio, and for senior, mezzanine and junior SBBS, except for the case of junior SBBS where the reward for risk is no longer such an outlier. The euro area portfolio performs best overall (although it should be recalled that this portfolio has little of the hedging properties possessed by the German or senior SBBS). Senior SBBS have a reward for risk which is similar to that of the German bond. Overall, the SBBS are not out-of-line with other similarly risky single-name sovereign bonds in terms of their reward for risk.

1.5.4 Conclusion

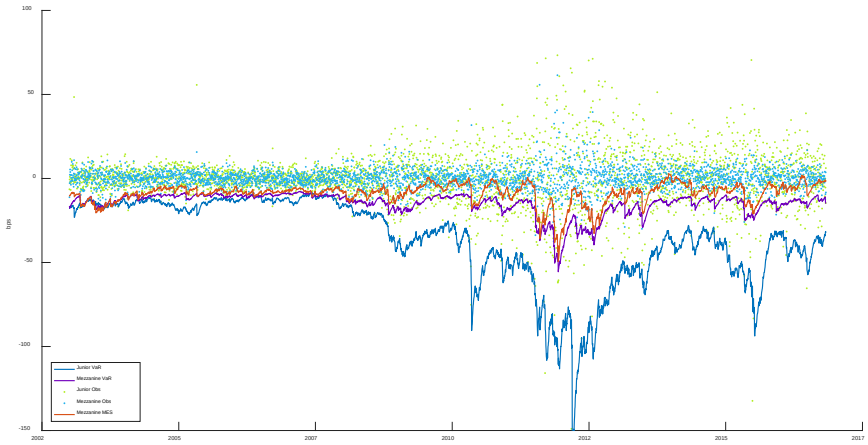
The foregoing analysis examines the ex ante tail-risk characteristics of SBBS. The results of this analysis largely confirm the simulation-based results reported earlier in this section. These found that senior SBBS would be slightly lower risk than even the lowest-risk euro area sovereign bond. VaR and MES measures confirm that senior SBBS entail a risk level similar to that of the lowest-risk euro area sovereign (including as a hedge against the extreme risk of multiple defaults). Mezzanine SBBS are similar to Spanish and Italian bonds using all risk measures. 10%-thick junior SBBS are not as risky as the riskiest single-name sovereign bond, but are usually riskier than the second most risky sovereign. On this basis, junior SBBS may attract additional investor interest under the condition of adequate liquidity.

The findings show that senior SBBS have a yield-to-maturity relative to VaR that is similar to that of the German sovereign bond. Junior SBBS frequently outperform in terms of the dynamic Sharpe ratio, but in the pre-crisis period and at the end of the sample it underperforms. However, junior SBBS may benefit from higher coupons (insofar as there is a positive excess spread) and may be more liquid than comparable individual sovereign bonds. This would make them relatively more attractive to investors.

While the VAR-for-VaR approach is flexible in that it allows for cross-effects, it does not allow for changing parameters in the VAR. Tail risk spillovers may primarily be a feature of crisis circumstances. Therefore, allowing for parameters to switch in such circumstances may materially affect the findings above. The MES analysis highlights that the correlation between low-risk and high-risk assets matters for the perceived (and actual) riskiness of an asset in crisis situations. Some individual sovereign bonds have attractive hedging properties (i.e. high MES) and, while this feature is passed on to senior SBBS, it may be counteracted by actual exposure to losses in the rare circumstance of a large number of defaults. The simulations take this into account by assuming high default correlation in each period. While the yield estimation process has been calibrated to guard against a low-riskiness bias, the benefits that SBBS might bring in terms of reducing risks due the weakening of the bank-sovereign nexus are not taken into account. The findings presented here can therefore be interpreted as a conservative lower bound, given that they do not factor in general equilibrium effects brought about by a reduction in the bank-sovereign nexus.

Figure 1.17
Mezzanine and junior SBBS risk measures

(in basis points)

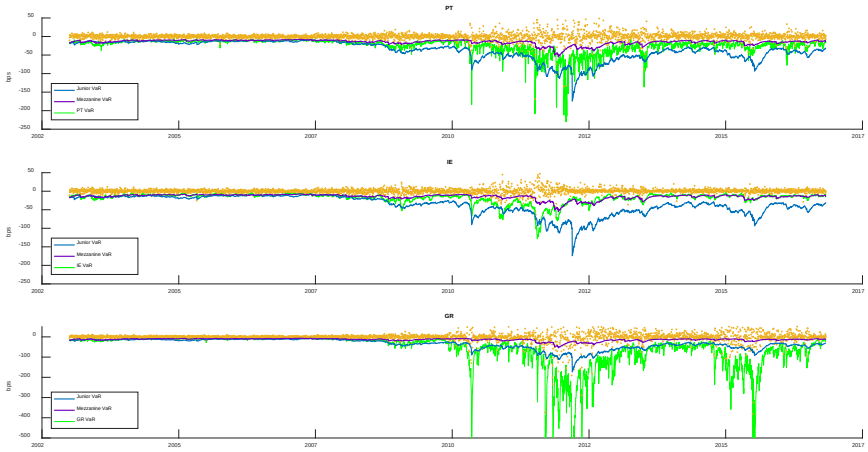


Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows dot plots of the observed changes in yields (in basis points) on mezzanine (light blue dots) and junior (light-green dots) SBBS, along with 1% VaR and MES, for the standard 70-20-10 seniority structure. The blue and dark blue lines represent the 1% VaRs for junior and mezzanine SBBS respectively, while the MES for the case of mezzanine SBBS, conditional on junior SBBS having a yield change more negative than their VaR, is displayed as a dark red line.

Figure 1.18

Junior and mezzanine SBBS VaRs compared with those of single-name sovereign bonds

(in basis points)

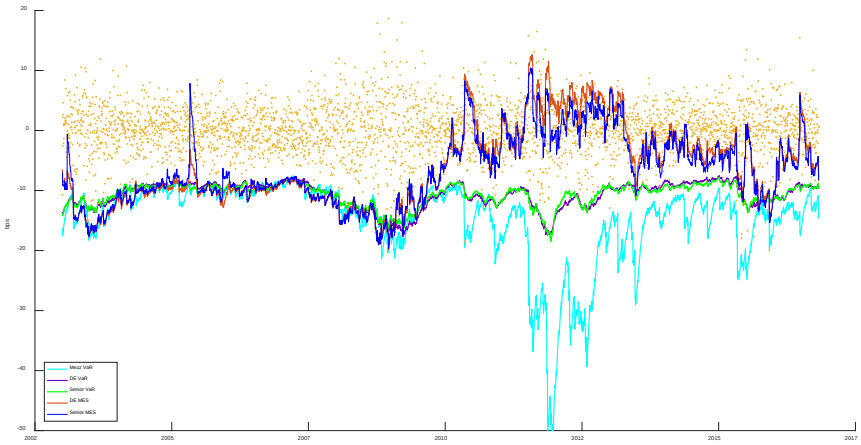


Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows the 1% VaRs of 10%-thick junior SBBS and 20%-thick mezzanine SBBS compared with the 1% VaRs of government bonds issued by Portugal, Ireland and Greece.

Figure 1.19

MES and VaR for German bonds compared with senior and mezzanine SBBS

(in basis points)

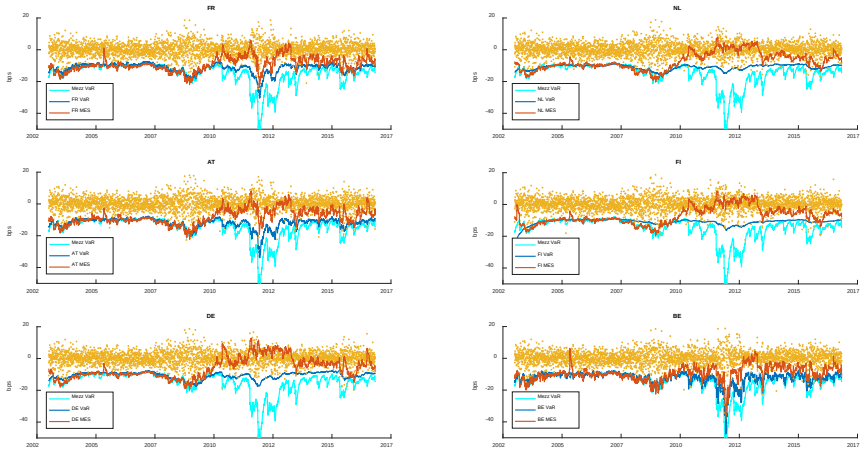


Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows the VaR and MES (in basis points) of the 10-year German sovereign bond and senior and mezzanine SBBS in the standard 70-20-10 seniority structure. MES is measured here as the ES conditional on tail events in mezzanine SBBS exceeding the 1% VaR of that security (which can only occur after junior SBBS have been wiped out).

Figure 1.20

VaR and MES of lower-risk euro area sovereign bonds

(in basis points)

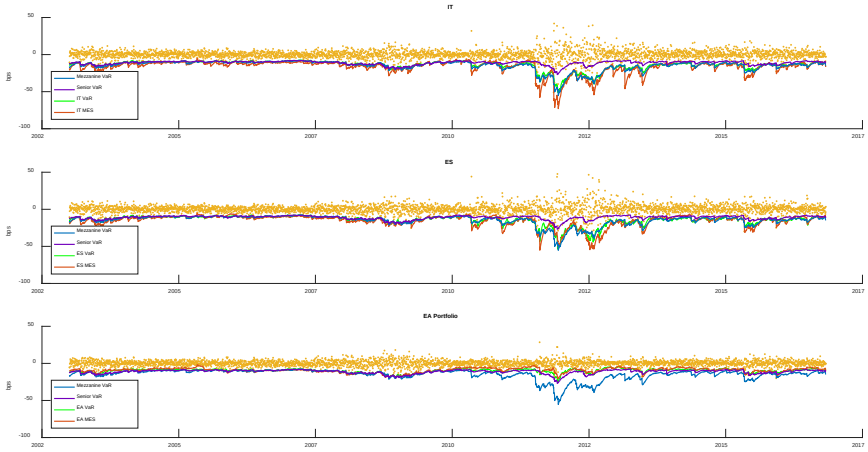


Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows the VaR and MES (in basis points) of six single-name euro area sovereign bonds compared with the VaR of mezzanine SBBS in the standard 70-20-10 seniority structure.

Figure 1.21

VaR and MES of mezzanine and senior SBBS compared with national sovereign bonds

(in basis points)



Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows the VaR and MES of Italian and Spanish sovereign bonds and those of a euro area GDP-weighted portfolio. These are compared with the 1% VaR of senior and mezzanine SBBS in the standard 70-20-10 seniority structure.

Figure 1.22

Dynamic Sharpe ratios for SBBS and German sovereign bonds

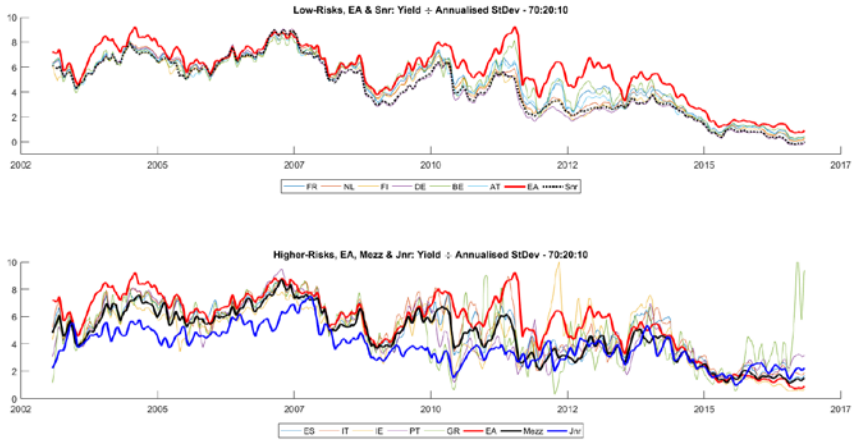
(excess returns per unit of conditional standard deviation)

Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure shows the monthly dynamic Sharpe ratio associated with holdings of 10-year senior, mezzanine and junior SBBS (in the 70-20-20 structure) and German sovereign bonds. In each case, the coupon is allowed to have an upper and lower bound of one standard deviation around the chosen rate based on the standard error of the intercept coefficient in the regression of the coupon spread on yield spread.

Figure 1.23

Dynamic quasi-Sharpe ratio: yield for annualised risk

(excess returns per unit of conditional standard deviation)



Source: De Sola Perea, Dunne, Puhl and Reininger (2018) and ESRB calculations.
Note: The figure plots the dynamic quasi-Sharpe ratio, i.e. yield for annualised risk. In this case, risk is measured by GJR-GARCH conditional volatility.

1.6 Assessing effects on interconnectedness

Cronin and Dunne (2018) apply the Diebold-Yilmaz (2012) spillover index methodology to the SBBS yields estimated in Section 1.4. The analysis focuses on the 70-30 and 70-20-10 seniority structures using data from 2000 to 2016. The econometric approach can assess any potential attenuation of the spillover of shocks across markets that would result from introducing SBBS. The main finding is that the spillover of shocks between the securities is lower than that between 11 euro area Member States' bond markets. In addition, spillover values among the securities fall during the euro area sovereign crisis. Senior SBBS are more resilient to shocks in the subordinated securities during periods of financial stress in the standard 70-20-10 seniority structure.

The results in Sections 1.2 and 1.3 suggest that senior SBBS would be slightly less risky than German sovereign bonds. In a world with SBBS, cross-country spillovers of sovereign risk (operating via the banking system) would be reduced insofar as banks reinvest their sovereign bond portfolios into low-risk senior SBBS. Spillovers are important since they have endogenous knock-on effects on risk-taking and investment behaviour. A measure of interconnectedness and interaction between asset markets is given by the spillover index approach proposed by Diebold and Yilmaz (2012), which was applied in a similar context by Conefrey and Cronin (2015) and draws on the work of Koop, Pesaran and Potter (1996). The spillover index provides information on whether asset markets become more distinct from one another over time by quantifying the relative importance of own-market shocks and other-market (cross-market) shocks. A lower spillover index, which arises when own-market shocks are more dominant, indicates a weaker influence of cross-market shocks, i.e. less interconnectedness. This approach can therefore be used to measure any attenuation of the spillover of shocks across markets due to the introduction of SBBS. The objective of the analysis is to compare the spillovers of shocks to returns for investors in euro area bonds as opposed to senior SBBS. The approach therefore does not constitute a full counterfactual analysis. Instead, it uses historical information on national bond markets to derive plausible estimates of spillovers for SBBS. The historical experience can be regarded as indicative of what would happen under similar levels of stress as prevailed, for example, in 2011 and 2012. Nevertheless, it abstracts from the reduction in the risk that such an event would arise due to a weakening of the bank-sovereign nexus following the introduction of SBBS.

The Diebold-Yilmaz methodology relies on forecast error variance decompositions provided by vector autoregression (VAR) estimations applied to times series data. The variance decomposition output is used to produce a total (or average) spillover index and spillover components, which can be presented in tabular or graphical form. For each asset, the sum of its cross-variance shares gives a measure of spillover from all other assets in the VAR estimation. Those asset-specific values (which can be assessed in their own right) are added together for all assets in the VAR and then averaged to find the total spillover index value. This methodology is applied to the estimated SBBS yields (described in Section 1.4) over the period from 2000 to 2016 and, for comparison, to 10-year benchmark sovereign yield data from 11 euro area bond markets (i.e. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain). The data are expressed as weekly changes in spreads over 10-year US Treasury bond yields. While full-sample results are reported in Cronin and Dunne (2018), the main focus is on spillover values produced using rolling windows of estimation. Each window is 200 weeks long, with the first having an end-date of 3 November 2003 and the last 31 October 2016.

In the first application of the Diebold-Yilmaz approach, a lower average spillover of shocks arises between SBBS compared to that which occurs between the 11 euro area sovereign bond markets (see Figure 1.24). Average spillover values fall across the 11 national markets and the two SBBS seniority structures (of 70-30 and 70-20-10) and remain lower in the post-crisis period than before the crisis. This decline is sharpest for the 70-30 seniority structure, while the fall in the 70-20-10 structure matches that of national sovereign bonds. The evidence therefore suggests that tranching reduces the overall potential for shocks to be transmitted across markets, particularly in periods of financial stress.

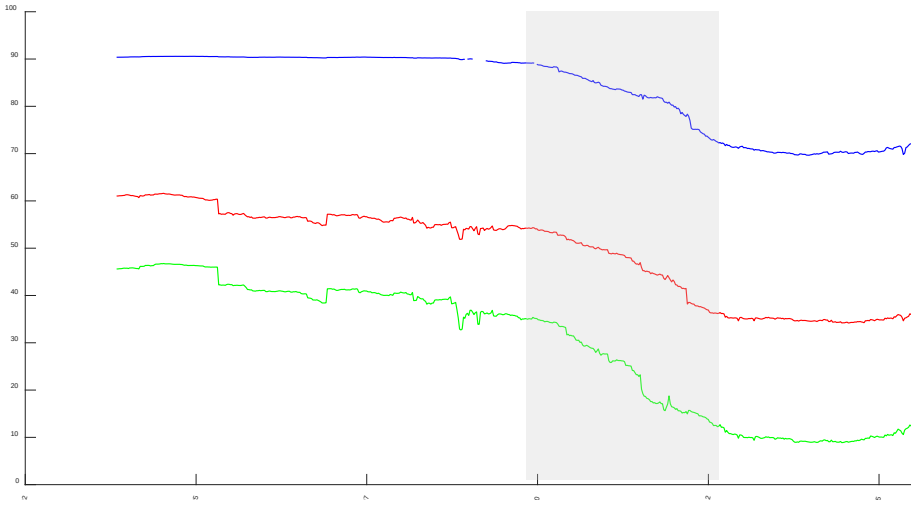
In the three-tier structure, the spillover of shocks from the mezzanine and junior securities to senior SBBS declines during the sovereign bond market crisis of 2009-12 and remains lower in its wake (Figure 1.25). Likewise, its influence on non-senior SBBS declines. This implies that senior SBBS become more detached from the influence of the other two securities during the crisis and remains so afterwards. This underscores the increasing positive externalities that arise from tranching, and the scope for risks to remain within the non-senior markets. It furthermore indicates the importance of looking at the full range of risk measures produced in this section when evaluating the overall risk of the securities.

There are many ways to assess the degree to which senior SBBS would be protected from default-related losses. The Diebold-Yilmaz approach allows for a generalised assessment of whether the spillover of shocks within markets would diminish. The findings indicate that secondary market spillovers would be reduced under SBBS, which provide investors with a vehicle to avoid valuation spillovers from random valuation shocks to individual sovereigns. The main caveat is that the historical bond data from which SBBS yields are derived is only indicative of what would occur under similar levels of stress in future. If SBBS were to weaken the bank-sovereign nexus, stress events might become less frequent and less severe.

Figure 1.24

Total spillover indexes

(in percent)

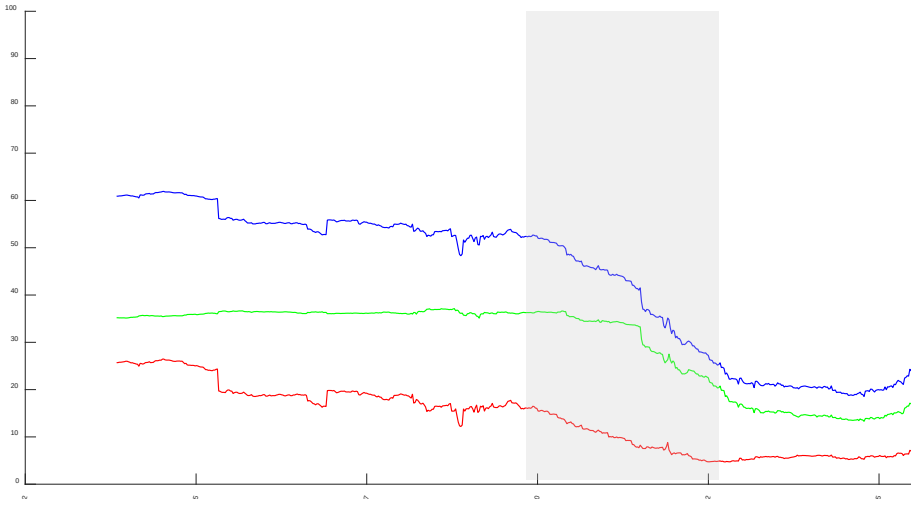


Source: Cronin and Dunne (2018) and ESRB calculations.
Note: The figure shows 200-week rolling windows of the total spillover indexes for senior, mezzanine and junior SBBS. The shaded area indicates the period from November 2009 to August 2012, which spans the euro area sovereign debt crisis.

Figure 1.25

Spillover to senior SBBS (70-20-10 case)

(in percent)



Source: Cronin and Dunne (2018) and ESRB calculations.
Note: The figure shows 200-week rolling windows of the spillover to senior SBBS from mezzanine and junior SBBS. The shaded area indicates the period from November 2009 to August 2012, which spans the euro area sovereign debt crisis.

2 Contractual features and debt restructuring events

This section outlines the contractual features of SBBS. These novel securities bear some similarity to certain features of existing sovereign bonds, covered bonds and securitisations. However, they are also a sui generis product, which allows for a bespoke contractual design. Crucially, SBBS should be designed so as not to distort the incentives of governments to service their debt obligations selectively. Moreover, the design of SBBS should be made robust to sovereign default events by precisely specifying the contractual obligations of contracted parties. When a sovereign bond restructuring is proposed, SBBS issuers would posses formal voting rights, and should be instructed on how to vote either by a third-party trustee with a fiduciary duty to SBBS investors or by SBBS investors themselves. Different options for how to aggregate SBBS investors' preferences are discussed.

2.1 Contractual features

SBBS would be a new financial product, combining elements of sovereign bonds, covered bonds and securitisations. Their implementation would therefore require careful contract design to make the securities attractive to investors. From a policy perspective, the basic requirement of SBBS is that sovereign debt restructuring be managed in a predictable and efficient manner, and that the introduction of SBBS does not distort the incentives of government with respect to selective default decisions. Procedural transparency and legal certainty about the risks of the three securities would be crucial. Market participants might potentially be willing to accept uncertainty about key features of SBBS during benign financial conditions. In periods of financial stress, however, demand for SBBS (particularly junior SBBS) could diminish abruptly if a weak procedural and legal framework were to translate into prohibitively high risk premia.

To achieve a strong legal framework for SBBS, lessons can be learned from legal experiences with securitisations and covered bonds, where non-payment on the underlying cash flow-generating assets does not create contagion to the arranger. This section outlines the legal features of securitisations and covered bonds that help to achieve this outcome, which provides an indication of the corresponding features that would be desirable in any SBBS contract.

Like issuers of securitisations and many covered bonds, issuers of SBBS would be bankruptcy-remote from their original arranger. Securitised products create security in favour of investors over all assets in the cover pool (as well as the issuer's bank accounts and any other contractual rights vis-à-vis third parties). Proceeds from the underlying cash flow-generating assets are passed on to the investors by the issuing entity (net of small administrative costs). The entity is bankruptcy-remote from its arranger, as it is an independently established company with independent directors and no employees, previous trading or indebtedness. This ensures that the issuer would not be brought into insolvency proceedings associated with its arranger.

SBBS differ from covered bonds as they are backed only by the underlying pool (also known as "single recourse"). Covered bonds generate a security interest in favour of the investor. SBBS are also secured on the underlying bonds, but without over-collateralisation or double recourse,

which are key features of covered bonds. There may also be modifications to national insolvency rules to protect holders of legislative covered bonds. Other notable differences between legislative covered bonds and plain vanilla securitisations include that: (i) the covered bond issuer can also be the originator of the cover assets; (ii) the covered bonds will not be tranched, unlike securitised products; and (iii) a securitised product will not incorporate dual recourse, unlike a covered bond. If the cover pool is not sufficient to satisfy the investor's claim, dual recourse allows that investor to become an unsecured creditor of the originator's insolvency estate. Tranching also distinguishes SBBS from covered bonds, making them more similar to a structured product in that regard.

The rights of investors to payments on SBBS (or other securitised products) are determined by a contractually agreed priority of payments waterfall (both pre-enforcement and post-enforcement). A post-enforcement priority of payments waterfall is triggered by a default on the securitised products. Investors agree to contractually limited recourse and non-petition provisions; their claims against the issuing entity are limited to the assets secured in their favour. This means that recourse is solely to the secured assets of the issuing entity; investors may not initiate insolvency proceedings against the issuing entity following non-payments on those assets.

Two elements distinguish SBBS from securitised products (and covered bonds). First, junior SBBS would be held by third-party investors, and not retained by SBBS arranger(s) or issuers. Second, the cover pool would comprise central government bonds. The legal framework for SBBS is therefore similar to that for securitised products, but the following factors should be considered when defining the legal framework for SBBS:

- **Governing law of SBBS:** As with standard securitised products, an SBBS investor needing to make a claim against an SBBS issuer with regard to non-payment would need to do so under the law governing those securitised products. SBBS holders would have limited recourse (against the SBBS issuer only). To improve homogeneity across different SBBS series, it may be preferable for all SBBS to be subject to the same governing law.

- **Governing law of the SBBS issuer:** Similarly, the law of incorporation of SBBS issuers determines the insolvency laws to which they would be subject following an insolvency event. Note that the jurisdiction of incorporation of SBBS issuers would not need to be the same as the jurisdiction specified for the governing law of the SBBS.

- **Governing law of the cash flow-generating assets:** As with standard securitised products, the sovereign bonds backing SBBS would need to be acquired under the laws governing such assets. Individual sovereign bonds backing the SBBS would normally be governed by the law of the sovereign issuing the relevant sovereign bond. However, the laws of another jurisdiction, such as England and Wales, could apply in some cases.

- **Governing law of the security:** SBBS contracts would need to cover the rights of issuers (as owners of the sovereign bonds) under any master purchase agreement. In addition, they should secure in favour of the bondholders the rights of the issuer (as owner) to the sovereign bonds at each relevant central securities depositary.

- **Governing law of key transaction parties:** As with standard securitised products, the solvency regime of transaction parties would be relevant in any insolvency proceeding.

2.2 Debt restructuring events

To fulfil the policy objectives, the design of SBBS must ensure that the senior security represents a euro area-wide low-risk asset without joint liability. Neither EU Member States nor EU institutions would assume any risks or cover losses related to SBBS payment flows, even in a debt restructuring event. With SBBS, sovereign debt restructuring should remain possible if the solvency of a Member State is questionable.

A basic principle of SBBS is therefore that their introduction should be neutral with respect to sovereign debt restructuring. With this in mind, the rest of this section considers aspects of SBBS design related to debt restructuring. The analysis is structured under five headings, broadly corresponding to the chronological sequence of a hypothetical sovereign debt restructuring event. In particular:

1. **Creditor non-discrimination:** Would SBBS create incentives for governments to default in a way that selectively targets certain creditors or debt instruments (e.g. SBBS)? If so, how could SBBS be designed to preclude selective default?

2. **Debt non-payment:** If non-payment on sovereign debt in the SBBS cover pool leads to (partial) default on that debt, what would be the implications for SBBS? Would SBBS also be in default?

3. **Restructuring procedure:** How should sovereign debt restructuring be dealt with under SBBS? How should creditor voting rights be allocated and aggregated (also considering the behaviour of holdout investors)?

4. **Debt modification:** Once renegotiation has taken place, how should modified sovereign debt be included in the SBBS cover pool, particularly if the modification includes a maturity extension?

5. **Institutional framework:** Given the role of the ESM in providing stability support loans to Member States in difficulty, in what way, if any, would ESM be involved with SBBS?

These questions touch on complex issues related to the economics, law and political economy of sovereign debt restructuring. Analysis indicates a challenging balancing act in the design of SBBS, which would indeed be relevant for the credibility of sovereign debt restructuring arrangements in the euro area. Bad SBBS design could disrupt debt restructuring processes. Better SBBS design choices have the potential to enhance the credibility of the euro area's institutional arrangements for sovereign debt restructuring. In addition, it must be borne in mind that SBBS need to be accepted by the market. This means that they would need to be structured as simply and transparently as possible, making use of standard securitisation features where feasible.

2.2.1 Creditor non-discrimination

A frequently voiced concern is that, in a new euro area fiscal crisis, junior SBBS might look so risky that investors would no longer be willing to buy them. While in principle yields should adjust to clear the market for all three securities, it is possible that the pool of investors willing to purchase junior SBBS would be limited, even at very high yields. According to this concern, loss of market access for junior SBBS, and therefore the entire SBBS structure, may follow.

Loss of SBBS market access would create problems for euro area countries that may come to rely on SBBS to issue debt. In this event, countries might be forced to suddenly issue large quantities of their own securities in ordinary primary markets (i.e. outside of SBBS). In extreme circumstances, there could be pressure to make official purchases of junior SBBS to keep SBBS issuance flowing. If these purchases were to take place at higher than market prices, they could become a source of moral hazard and fiscal transfers (so-called "backdoor mutualisation"). Crucially, SBBS should be designed to preclude any eventuality in which the public sector conducts off-market purchases of junior SBBS as a crisis management tool.

It is therefore essential for SBBS to retain the same market access as their underlying components (i.e. that neutrality holds). Payoff neutrality is obtained if an SBBS replicating portfolio has the same payoff structure in every state of the world as national bonds held directly. In legal terms, this depends on three jointly sufficient conditions:[23]

1. The cover pool of newly issued SBBS only contains bonds with a secondary market clearing price, and not bonds of countries that have lost market access (the "market access" criterion).[24]

2. SBBS issuers pass on payoffs from the bond pool to SBBS investors without adding any risk of their own (i.e. there is no counterparty risk).

3. In a restructuring event, sovereign bonds in the SBBS cover pool are restructured in the same way as equivalent sovereign bonds held by investors directly ("principle of equal treatment"). In other words, the treatment of bonds by a defaulting sovereign does not discriminate by the identity of the bondholder.

An additional condition (4) would be needed insofar as some investors care about bonds' non-pecuniary benefits. This fourth condition states that SBBS and the basket of underlying

[23] Importantly, these conditions are jointly sufficient, but not necessary, to guarantee that SBBS retain market access. For example, it is possible to imagine cases in which SBBS retain market access even though their collateral pool contains bonds that are being restructured. This is because the weight of these bonds may be small and/or the LGD of these bonds is less than 100% and the yields on SBBS of different seniority will adjust to compensate investors for the risks involved.

[24] The "market access" criterion states that any sovereign without access to global capital markets would be excluded from the cover pools of new SBBS issues that are assembled from primary markets. Upon regaining primary market access, participating Member States may be included in new SBBS issues in proportion to the volume of debt that they issue in primary markets (and in compliance with their target weight in the portfolio based on the ECB capital key). Secondary market purchases could still occur if competitive market prices exist. Note that this market access criterion implies that SBBS are issued as multiple distinct vintages, rather than from a single revolving portfolio based on a master prospectus. In the latter case, newly issued SBBS would have a claim on all legacy bonds in the cover pool, which would include bonds that may subsequently have lost market access. However, a revolving portfolio could be consistent with the market access criterion if an entirely new master prospectus is created if and when any country loses market access. In this case, the old master prospectus would be slowly retired, as no new SBBS would be issued from it.

bonds held directly offer similar non-pecuniary services. For example, one non-pecuniary benefit could arise from the eligibility of SBBS for use as collateral compared with government bonds. In addition, regulatory treatment may affect the non-pecuniary benefits of SBBS compared with bonds held directly.

To see why these conditions ensure SBBS market access, consider a basket of bonds with identical weights to bonds in the SBBS cover pool. The cover pool of newly issued SBBS only contains bonds that trade at market clearing prices (according to condition (1)), so there must be a buyer for the basket of bonds underlying SBBS, and therefore for an equivalent replicating SBBS portfolio. Condition (2) ensures that SBBS issuers pass on exactly these payoffs to SBBS holders without adding further counterparty risk. Moreover, in a debt restructuring procedure, sovereign bonds in the SBBS cover pool are treated in the same way, from the perspective of bondholders, as sovereign bonds held by investors directly (condition (3)). Condition (4) ensures that there are no cash flow-related reasons to prefer holding the bond basket to SBBS. Hence, given the first three "payoff neutrality" conditions and the fourth "neutrality of non-pecuniary benefits" condition, marginal investors would be indifferent as to whether they hold the SBBS replicating portfolio or national sovereign bonds directly.

Conditions (1) and (2) are extensively discussed elsewhere in this report. They are satisfied through the rules that SBBS issuers must follow and the process by which SBBS are issued. These include: (i) a "market access criterion" in the SBBS regulation, which would specify that all sovereign debt included in new SBBS issues must have a market clearing price (satisfying condition (1)), and (ii) the bankruptcy-remoteness of SBBS issuers from their arranger(s) (satisfying condition (2)).

To see how condition (3) might be violated, suppose that the bond series of a country that is held by investors directly differs from series in the SBBS collateral pool. Furthermore, assume that the investors which hold bonds directly are mostly domestic residents. In the event of a debt crisis, the government may be tempted to default selectively on the bonds held in the SBBS structure (or settle on better terms with resident bondholders) to the detriment of the SBBS holders. If this were to occur, it would undermine the SBBS market to the point that, in a fiscal crisis, market access might indeed be lost for SBBS before sovereign bonds. This demonstrates how condition (1) on market access is not sufficient to protect the integrity of SBBS.

An additional device is therefore needed to satisfy condition (3). One solution could be to require the bonds underlying SBBS to include fixed fractions of all international securities identification numbers (ISINs) issued by each sovereign. However, this would be operationally challenging for arranger(s) to achieve. This purported solution might anyway not be robust to manipulation, as governments could selectively swap certain bonds for new ones with new ISINs according to the identities of the bondholders, resulting in discrimination by penalising the holders of the remaining bonds relative to holders of the new ISINs. Instead, creditor discrimination could be avoided either in the form of a new provision in euro area sovereign bond contracts or an equivalent provision in the EU regulation governing SBBS. The latter is preferable as it would immediately cover all outstanding sovereign bond issues, whereas modifying bond terms would affect only new issues.

A non-discrimination provision should therefore be included in the SBBS-specific regulation to avoid creditor discrimination. Such a clause should include the following elements:

- the definition of a creditor pool within which discrimination is prohibited;
- a comprehensive definition of actions with which governments might seek to influence the returns or value of bonds (including specific actions such as offering a debt exchange, but also a broader definition that includes other unforeseen actions);
- a stipulation that if any such action makes some creditors better off, it will automatically apply to all creditors, including SBBS issuers.

This non-discrimination provision would also ensure that holdout investors do not receive abnormal payoffs by holding national bonds directly. Owing to the diversified cover pool underlying SBBS, holdout investors would typically not use SBBS to acquire voting rights. Instead, they would prefer to hold national bonds directly. Direct legal ownership would also enable holdout investors to aggressively pursue litigation. Their preference for national sovereign bonds would be problematic insofar as ordinary investors would free-ride on the holdout investors. This would violate neutrality condition (3), given that a bond undergoing restructuring will have a higher expected return if it is held directly rather than indirectly via SBBS (assuming that holding out has a non-zero probability of success). A non-discrimination provision in the SBBS regulation would solve this problem as its application would ensure the equal treatment of bonds inside and outside SBBS. In this way, holdout investors could not be treated preferentially over SBBS issuers and other legal owners of sovereign bonds.

2.2.2 Debt non-payment

Another frequently voiced concern is that any (partially) missed coupon or principal payment on any bond in the SBBS cover pool would cause the marginal SBBS class to be in "technical default". In this case, the probability of a junior SBBS holder incurring a missed payment would be at least as high as the probability of non-payment on the highest-risk sovereign bond. This potential problem can be forestalled by an appropriately complete SBBS contract.

To provide certainty to investors, an SBBS contract would specify the contractual obligations of SBBS issuers in every possible circumstance – including benign states of the world (in which all sovereign bonds continue to be serviced) and bad states (including all possible non-payment events). As long as SBBS issuers respect these obligations, they can never be in default of the contract, which defines the obligations of SBBS issuers in all states of the world, including events of sovereign bond non-payment. This distinguishes SBBS from sovereign bonds, which promise a predefined payment stream (or, in the case of CPI- or GDP-indexed bonds, payment according to a predefined formula) in every state of the world.

To understand how to make SBBS contracts complete, consider the following. Imagine for the sake of simplicity that there are two possible states of the world: all bonds in the SBBS cover pool continue to be serviced (denoted by input X) or some fraction is not serviced (denoted by ¬X). The complete SBBS contract specifies the contractual obligations of SBBS issuers in the event of X (i.e. SBBS payments are made to securities in accordance with the contract, denoted by output Y)

and ¬X. For example, in the event of ¬X, SBBS issuers apply a well-defined cash flow waterfall to coupon and principal payments, denoted by Z. A complete SBBS contract therefore follows the basic algorithmic rule: “If X, then Y; if ¬X, then Z”. In this way, the contractual obligations of SBBS issuers are specified in every possible state of the world.

Contract completeness implies that the role of SBBS issuers is algorithmic. When contracts are complete, SBBS issuers are simply robots, which deterministically deliver an output (i.e. cash flow allocation) for a given input (i.e. state of the world). This algorithmic nature of SBBS issuers also implies that SBBS could be serviced with low fees, since software can be scaled at negligible marginal cost. Mortgage-backed security (MBS) contracts provide an instructive example of a complete contract. Partial non-payments of underlying mortgages frequently occur. The non-performing mortgage is then said to be in default. But this does not lead to a default of the MBS, since the contract would specify the contingent obligations of the MBS issuer. This includes how the cash flow waterfall should be applied in each state of the world. The existence of legal solutions for complex mortgage markets implies that a solution for relatively straightforward sovereign debt markets should be feasible.

For end investors in MBS, non-payment risks arise from the performance of the underlying cover pool rather than contract incompleteness. Non-payment of underlying mortgages could give rise to substantial cash flow volatility for investors in subordinated securities. In many MBS, the risk of this cash flow volatility is borne by the servicer, which commits to advance coupon payments to MBS holders regardless of the performance of the underlying mortgages. Such advances apply only to promised coupon payments, so that the MBS continues to perform over the lifetime of the security, even in the event of defaults or modifications of the underlying mortgages. When the MBS matures, principal payments are allocated in accordance with the cash flow waterfall, with the servicer granted a super-senior claim (to recover its coupon advances plus interest), followed by senior MBS holders, and so on. As such, the most junior creditors only incur losses owing to non-payment of coupon or principal at the final maturity date of the MBS. They may also bear extension risk if mortgage workout continues after the original maturity of the MBS.

The standard “advances” solution used in MBS is problematic in the case of SBBS, as it would require the SBBS issuer to fund the advances. To meet SBBS policy objectives, it is essential for SBBS issuers to be algorithmic, and therefore unable to take discretionary decisions or risk on their own account. Although advances in MBS are typically limited to ensure that the sum of advance payments never exceeds eventual recovery on the mortgage in default, the calibration of such limits according to underlying market value may be subject to measurement error, particularly if the securities in default are illiquid. Given that the servicer has a super-senior claim on final principal payment upon maturity of the MBS, over-payment of advances to junior creditors over the lifetime of the MBS may result in only partial payment of principal to senior creditors (after the servicer has satisfied its super-senior claim). This could violate the policy objective of creating a credible low-risk asset with senior SBBS.

Payments of coupon (as well as principal) in the case of SBBS should therefore be made in accordance with the cash flow waterfall, without resorting to advances. In the event of coupon non-payment on an underlying bond or bonds, coupons from performing bonds would first be paid to senior SBBS; if their nominal claim is entirely satisfied, remaining coupons would be paid to mezzanine SBBS. The cash flow waterfall would therefore be sufficient to ensure the proper application of the seniority structure at any given point in time. While the cash flow waterfall thus

ensures intratemporal seniority (i.e. seniority of payments made in any given payment period), it does not guarantee intertemporal seniority (i.e. seniority of payments made over the life-cycle of the SBBS). Given that the cash flow waterfall applies intratemporally (i.e. period by period), it is possible that junior SBBS coupons would be paid in the early stage of the life of an SBBS contract, but that a subsequent large sovereign debt default would lead to non-payment of coupons on mezzanine as well as junior SBBS. In most cases, subsequent recovery would be sufficient, so SBBS issuers could later pay the forgone coupon on mezzanine SBBS by applying an adequate haircut to subsequent coupons and principal that would otherwise be paid to junior SBBS holders. However, in extreme scenarios, it is possible that mezzanine holders would never receive the forgone coupon payment, even though junior SBBS holders had previously received coupon payments before the sovereign default event.

Intertemporal seniority is not a standard feature of existing securitisation contracts. No securitisation contract is designed to provide for intertemporal seniority. Rather, cash flow waterfalls are applied in standard contracts with respect to current and future periods. Intertemporal seniority could be adopted in the case of SBBS to lower the risk borne by senior SBBS holders. Although this might be desirable considering the policy objective of creating a low-risk security, intertemporal seniority would be a non-standard contract feature, which argues against including it in SBBS contracts. Nevertheless, if investors placed significant importance on intertemporal seniority, it could be achieved by designing junior SBBS as "zero coupon" securities.[25] With zero coupon junior SBBS, the only nominal payment would take place when the SBBS contract matures. At this date, junior SBBS investors would receive the remaining principal after senior and mezzanine SBBS are paid in full, plus any accumulated coupons from national bonds (but which were not passed on to SBBS investors over the lifetime of the contract), plus any interest that may have accrued from reinvestment of those accumulated coupons. Zero coupon junior SBBS may be problematic in other respects, however. The absence of a regular stream of payments may render junior SBBS less attractive to certain categories of investors, particularly liquidity-constrained investors for whom regular payments are an important component of the payoff structure. Although it is theoretically possible to replicate such payments by realising capital gains on zero coupon securities, behavioural biases and transaction costs may prevent replication from taking place in practice. Consequently, zero coupon junior SBBS could be a source of non-neutrality with respect to the underlying cover pool. This is because the payoff structure of an SBBS replicating portfolio would be more back-loaded than a portfolio in which coupon-yielding sovereign bonds are held directly. Moreover, from the perspective of SBBS design, zero coupon junior SBBS would require a reinvestment policy for the cash received by SBBS issuers as coupon payments on sovereign bonds. These questions would need to be studied in more detail before deciding in favour of zero coupon junior SBBS.

[25] A similar logic could also apply to mezzanine SBBS to preserve the intertemporal seniority of senior SBBS. In this case, "junior" should read "non-senior", and senior SBBS would therefore be the only coupon-yielding security.

2.2.3 Restructuring procedure

In a debt restructuring process, creditors typically have the right to vote on a proposed modification. Since 1 January 2013, euro area Member States have inserted standardised collective action clauses (CACs) into the contractual documentation of their debt securities with a maturity of more than one year. The objective of CACs is to support a more orderly restructuring of sovereign debt restructuring if such an event were to occur (see Box 2.A for details on CACs). In the case of SBBS, the issuers of SBBS are the legal owners of the bonds, giving them formal voting rights in a debt restructuring procedure subject to CACs. However, SBBS issuers should not take any discretionary decisions on debt restructuring, since SBBS issuers are intended to be algorithmic entities without any vested interest (so-called "skin in the game"). As such, SBBS issuers would need to be instructed how to cast their formal votes.

To maximise the chances of obtaining a restructuring outcome that is in the best interests of SBBS holders collectively, instructions on how to vote would need to be given to SBBS issuers by an entity with the duty or incentives to act accordingly. This could be done in two ways:

- first, a third-party trustee with a fiduciary duty is appointed in the SBBS contract to instruct SBBS issuers how to vote in a debt restructuring process;
- second, SBBS investors give instructions to SBBS issuers.

The rest of this section considers the design of these two options. Note that the two approaches could also be combined in a hybrid approach. For example, issuers could ask SBBS holders to submit their instructions and, in the event of abstention, forward that request to the trustee.

Box 2.A
Collective action clauses (CACs) and voting rights

By means of standardised CACs, euro area countries have agreed to a partial harmonisation of the applicable rules in the unlikely event of having to restructure their sovereign debt. In particular, the treaty establishing the European Stability Mechanism (ESM) requires all euro area government debt securities with a maturity of over one year to include CACs as of January 2013. These clauses permit the key terms of the sovereign bonds to be modified when a qualified majority of holders vote in favour of modification.

SBBS holders would not, however, hold sovereign bonds directly. The rights attached to the underlying securities would ordinarily remain with SBBS issuers, which may exercise those rights, including when voting on proposed modifications. To avoid a situation in which SBBS issuers would need to make discretionary decisions concerning a proposed sovereign debt restructuring, SBBS could be structured to transfer voting rights from the underlying bonds to SBBS. Under this model, issuing entities would simply pass on voting rights to SBBS holders (or third-party trustees of their choosing). Following a vote on a modification proposal by SBBS holders, the issuer would be instructed to exercise its formal voting rights accordingly. This would avoid a situation where investors bear losses without exercising voting rights. Different legal options exist as to how to assign voting rights in the interests of the SBBS holders, as discussed in Section 2.2.3. The

feasibility of disentangling the exercise of voting rights attached to sovereign bonds from their legal ownership by the issuing entity would depend on the legal framework of the jurisdiction where the entity is established.

In the case of public arrangement, the euro area model CAC includes specific rules for disenfranchisement, according to which sovereign bonds are not included in the calculation of the required majority when the holder is directly or indirectly controlled by the issuer of such sovereign bonds. An exception to this rule occurs when the holder has autonomy of decision, in particular when it has a fiduciary duty to vote in the interests of one or more persons other than the issuer of the sovereign bonds for which a modification is proposed. As such, public arrangement of SBBS would not interfere with the operation of euro area model CACs or the contractual rights of SBBS investors to exercise their interests in a sovereign debt restructuring process.

Option 1: Voting instructions from a third-party trustee

Under this option, the security interest over the cash flow-generating assets could be held by a third-party trustee with a fiduciary duty to the investors.[26] In the event of non-payment on the sovereign bonds (or upon the occurrence of any other agreed non-payment event), the trustee can take legal ownership of and manage or sell the cash flow-generating assets so as to apply the proceeds in favour of the investors. A typical SBBS would also incorporate two features that are of particular relevance in the context of non-payments on sovereign bonds. The first such feature is the incorporation of a comprehensive set of non-payment events in the contract. The occurrence of such contractually defined events permits the trustee to take enforcement action on behalf of the bondholders. In this respect, the trustee can take steps in relation to the secured assets to realise the value of those assets in the best interests of the bondholders. The second key feature is the basic terms modification mechanism, which allows for bond terms to be adjusted, for example regarding payments, amounts outstanding or maturity. This enables the trustee to agree to a restructuring of the bonds in a manner that best protects the interests of SBBS investors.

In the context of a sovereign debt restructuring, the trustee would exercise voting rights on behalf of SBBS investors. The trustee would have a fiduciary duty to the SBBS holders collectively. As such, their role would be to instruct SBBS issuers how to vote in a bond restructuring in a way that maximises the value of the post-restructuring payment stream expected from the SBBS cover pool. To ensure that this fiduciary duty is fulfilled, the SBBS contract would specify the governance arrangements for actions undertaken by the trustee, including the mechanisms by which the trustee would be held accountable to SBBS holders collectively.

Making use of a third-party trustee is a straightforward solution that would avert the complexities of SBBS investors giving instructions directly to issuers. As an additional benefit, a third-party trustee would rule out any risk that holdout investors might acquire control rights via SBBS, since all investors would be disempowered in a debt restructuring process.

[26] "Security" or "security interest" is defined as the legal right granted by a debtor to a creditor over the debtor's property; it is not to be confused with the securities themselves, namely SBBS.

Instead, a third-party trustee would have a fiduciary duty to maximise the value of the SBBS cover pool: it would therefore act in these interests, rather than in the interests of holdout investors. This assessment implies that holdout investors would prefer to hold sovereign bonds directly.

A third-party trustee would need to be subject to a credible legal framework to ensure good governance. Without adequate oversight, trustees could be subject to considerable coercion or bribery by special interests during a debt restructuring event. Consequently, the SBBS product regulation together with its accompanying technical standards and guidelines would need to define the minimal legal and professional qualifications of the trustee.

Option 2: Voting instructions from SBBS investors

Under this option, SBBS issuers would receive voting instructions directly from SBBS holders. The first question that arises is which SBBS holders should give the voting instructions, given that SBBS holders are of three types: senior, mezzanine and junior. Under a look-through approach, voting instructions would be given in proportion to the thickness of the respective securities. This look-through approach would therefore give the highest weight to senior SBBS holders, owing to the 70% thickness of that security in the standard calibration of the seniority structure envisaged in this report. In most restructuring situations, however, senior SBBS holders would not have any skin in the game. This would lead them to vote for a suboptimally extensive restructuring (in the sense that a better restructuring deal would increase the payoffs to the marginal class of investor).

SBBS issuers could receive instructions from the marginal class of investor. The marginal class corresponds to the security that expects to receive more than zero (but less than its original claim) due to the losses inflicted by a debt restructuring. For holders of this marginal security, a higher value of the restructured bonds implies a higher expected payment stream. Hence, holders of the security have an incentive to exercise voting rights in a way that maximises the value of the cover pool.[27] This option requires (i) ex ante determination of the marginal class in any debt restructuring event, and (ii) a rule for the translation of instructions into formal votes. These two issues are analysed next.

[27] This, however, implies that the voting rights will not be exercised in a restructuring-friendly manner, as a debt restructuring event will affect the marginal class. Nevertheless, from an investor's perspective, there are good reasons to grant the marginal class the exclusive right to instruct the issuers how to vote.

Determination of the marginal class

In most restructuring situations, the marginal class would be the junior security.[28] For example, an idiosyncratic debt restructuring by any country with a weight of less than 10% implies that the junior security would be the marginal class because eventual losses will always be less than its 10% thickness. The same is true for any joint debt restructuring involving the following set of smaller countries, or any subset thereof: Cyprus, Estonia, Finland, Greece, Ireland, Lithuania, Luxembourg, Latvia, Malta, Portugal, Slovenia and Slovakia.

However, the marginal class is ambiguous in some situations: it could conceivably correspond to the junior, mezzanine or even senior SBBS in the most severe scenarios. The determination of the marginal class depends on (i) the number of countries in debt restructuring proceedings (or expected to begin such proceedings), and (ii) the expected recovery rates. For example, consider an idiosyncratic debt restructuring by any country with a weight of more than 10%, i.e. Spain, Italy, France or Germany. If the weighted average LGD were expected to exceed $0.10/w_x$, where w_x is the weight (in percent) of country x under debt restructuring, the mezzanine security would be the marginal class. Otherwise, the junior security would correspond to the marginal class.[29] A similar assessment applies to multiple default events that occur simultaneously.

Determining the marginal class ex ante (before the full extent of a default event is known) is complex. It requires an assessment of the countries that are expected to begin debt restructuring proceedings, and of the recovery that may be expected from those proceedings, before they have even begun. To address such complexity, determination should be entrusted to an independent outside entity without political or commercial interests. The advantage of this approach is that it is flexible with respect to the two key parameters (i.e. number of countries and LGD). This would be helpful if a country were on the verge of debt restructuring proceedings, since the outside entity could take this into account when determining the marginal class. In addition, this solution could accommodate new information about the severity of the underlying crisis that is revealed after the initial decision.

Another solution could be to use a fixed rule for the expected recovery rate. For example, if one were to assume LGD = 100%, the junior security would be the marginal class if the sum of the weights of the countries under debt restructuring were less than 10%. Alternatively, a lower LGD assumption could be used, such as 60%, which is more realistic than 100% but still conservative by historical standards. Another approach would be to apply an LGD corresponding to the difference between a country's debt-to-GDP ratio and the 60% Maastricht limit.

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[28] This would be in line with existing solutions in private securitisation markets, in which voting rights are typically allocated to the most junior tranche (or, similarly, a trustee acts on behalf of the most junior tranche). In most cases, though, the most junior tranche is partially retained by the issuer as skin in the game. This latter condition would not apply to SBBS, as issuers are intended to be pure pass-through entities.

[29] Note that there is no idiosyncratic debt restructuring that leads to senior SBBS being allocated to the marginal class, since $w_x<0.3$ in all cases.

Translation of instructions into formal votes

The marginal class approach requires a rule for mapping the instructions of marginal SBBS holders to formal SBBS issuer votes. If the restructuring concerns several underlying bonds, with portions of these bonds in the cover pools of more than one SBBS issued by more than one SBBS issuer, four different approaches could be taken (see Box 2.B for details):

1. **"Proportional representation."** In this approach, each issuer votes in favour of the debt restructuring with the voting mass corresponding to the SBBS marginal class holders that endorsed the restructuring. This approach can be seen as a neutral look-through approach.

2. **"First past the post at the level of each SBBS issue."** In this approach, each issuer votes in favour of the restructuring with the voting mass corresponding to all issues for which a (qualified) majority of marginal class holders support the restructuring.

3. **"First past the post at the level of each issuer."** In this approach, each issuer votes in favour of the restructuring with the entire voting mass under its control, if a (qualified) majority of marginal class holders across all of its issues support the restructuring.

4. **"First past the post at the level of all issuers."**[30] In this approach, all issuers vote in favour of the restructuring with the entire voting mass under their collective control, if a (qualified) majority of holders across all issues and issuers support the restructuring.

The three "first past the post" approaches could be applied at the level of each bond undergoing restructuring or at the level of all such bonds issued by the respective country. In the latter case, the SBBS contract would replicate one-limb aggregated CACs for the subset of sovereign bonds included in SBBS, without requiring any contractual modifications to those bonds.[31]

These different approaches represent a trade-off between avoiding free-riding by holdout investors and protecting creditor rights. The "proportional representation" approach would most faithfully replicate the current balance between holdout behaviour and creditor rights. In that sense, approach (1) can be seen as the SBBS design choice that would most closely approximate the status quo. Nevertheless, given the perennial problem of holdout behaviour in debt restructuring events and the externalities that such behaviour generates, one of the "first past the post" arrangements (i.e. approach (2), (3) or (4)) may be preferable. The most holdout-unfriendly option would be to choose approach (4) at the level of all bonds issued by the country undergoing restructuring.

[30] Note that option 4 is equivalent to option 3 if there is just one SBBS issuer.

[31] One-limb aggregation refers to a voting procedure in which the decision in favour or against a restructuring offer is taken based on one qualified majority among holders of all eligible bonds. The 2014 model CACs released by the International Capital Market Association (ICMA), and subsequently endorsed by the IMF, involve one-limb aggregation (Gelpern, 2014). By contrast, CACs currently contained in euro area sovereign bonds involve two-limb aggregation, as two qualified majorities – across all bonds, and bond by bond – need to be considered to restructure each bond issue.

Box 2.B

Mapping SBBS marginal class instructions to issuer votes in a proposed bond restructuring

This box focuses on the debt restructuring of one country that has issued I sovereign bonds that are contained in the cover pool of at least one SBBS j. For generality, suppose there are K SBBS issuers, indexed by k, that has each issued J_k SBBS, which contain at least one of the I bonds to be restructured. The total number of SBBS issues containing these bonds is therefore given by $\sum_{k=1}^{K} J_k$. The face value of bond i held in SBBS j is denoted by $s_{i,j}$, so the total face value of all bonds I held in all SBBS J_k and all issuers K is $\sum_{k=1}^{K}\sum_{j=1}^{J_k} s_{i,j}$.

For each SBBS issuer *k*, the matrix of the face values $s_{i,j}$ can be represented as follows:

		SBBS *j*				
		1	**2**	**…**	**$J-1$**	**J**
Sovereign bond i subject to restructuring	**1**	$s_{1,1}$	$s_{1,2}$	…	$s_{1,J-1}$	$s_{1,J}$
	2	$s_{2,1}$	$s_{2,2}$	…	$s_{2,J-1}$	$s_{2,J}$
	…	…	…	…	…	…
	I	$s_{I,1}$	$s_{I,2}$	…	$s_{I,J-1}$	$s_{I,J}$

Once the marginal class corresponding to a given debt restructuring event is identified, the holders of the $\sum_{k=1}^{K} J_k$ marginal securities would be asked to submit their instructions on how to vote. The marginal tranche of each SBBS j exercises all the voting mass implied by $s_{i,j}$.

The question is how these individual instructions by holders of the marginal security are mapped to formal votes. There are an arbitrary number of ways in which this could be done; for the purposes of discussion, it is useful to focus on four main alternatives.

"Proportional representation"

For each bond i being restructured and each SBBS contract j, the issuer would pass through the number of votes that it receives in favour of restructuring. Let $a_{i,j} \leq s_{i,j}$ denote the face value of the holders of issue j that voted to restructure bond i. Then, SBBS issuer k will cast $\sum_{j=1}^{J_k} a_{i,j}$ votes for restructuring bond i.[32] Across issuers, the total voting mass issued in favour of restructuring bond i will hence be $\sum_{k=1}^{K}\sum_{j=1}^{J_k} a_{i,j}$.[33]

First past the post voting at the level of each SBBS *j*

For each SBBS contract j, if a threshold of voting mass in favour of restructuring bond i is exceeded (this could be a CAC-style supermajority or a simple majority), each SBBS issuer k will cast all votes associated with the entire face value $s_{i,j}$ of bond i in issue j in favour of restructuring. Denote

[32] A similar logic applies for an issuer's pass-through of votes against restructuring as well as abstentions.

[33] The same result could have been established by asking all marginal class holders to send their preferences to just once central preference collection point, such as a trustee or an agency (e.g. the SBBS supervisor), and have the trustee or agency deliver the votes to the bondholder meeting on behalf of all issuers.

the set of SBBS issued by each k that voted for the restructuring with Ω_k. Then, issuer k will cast voting mass $\sum_{j\in\Omega_k} s_{i,j}$ votes for restructuring bond i. Across issuers, the total voting mass issued in favour of restructuring bond i from the SBBS universe will be $\sum_{k=1}^{K}\sum_{j\in\Omega_k} s_{i,j}$.

First past the post voting at the level of each SBBS issuer *k*

This approach is equivalent to the previous one, except that the relevant majority threshold is now defined at the level of each issuer rather than each issue. That is, if a (super-)majority of holders of the SBBS issued by k vote for the restructuring, k will cast all the voting mass in its possession – that is, $\sum_{j=1}^{J_k} s_{i,j}$ – in favour of restructuring. Denote the set of issuers that voted for the restructuring with Ψ_k. The total voting mass issued in favour of restructuring bond i from the SBBS universe will therefore be $\sum_{\Psi_k}\sum_{j=1}^{J_k} s_{i,j}$.

First past the post voting at the level of all SBBS issuers *K*

For each issuer k, a trustee or agency collects votes pertaining to bond i across each SBBS j. If a threshold of voting mass in favour of restructuring bond i is exceeded across all $\sum_{k=1}^{K} J_k$ issues containing bond i, then all issuers will be instructed to vote in favour of restructuring with the full voting mass in their possession, i.e. $\sum_{j=1}^{J_k} s_{i,j}$. Across issuers, the total voting mass issued in favour of restructuring bond i will be $\sum_{k=1}^{K}\sum_{j=1}^{J_k} s_{i,j}$, which corresponds to the maximal voting mass in the possession of all issuers K.

In addition, the three “first past the post” options could be implemented at the level of each bond i undergoing restructuring, which corresponds to the notation in this box, or at the level of each country, which might have issued multiple bond series. To represent the latter case, the notation i in this box can be interpreted as the set of all bonds issued by a given country that are undergoing restructuring, and I as the set of all bonds issued by all countries that are undergoing restructuring. By interpreting i and I in this way, it is possible to achieve one-limb aggregated CACs for the subset of sovereign bonds included in SBBS, without requiring any contractual modifications to those bonds. Such one-limb aggregation would interact with “first past the post” voting within SBBS, essentially nullifying the ability of investors to hold out in a debt restructuring process. In this way, SBBS could facilitate efficient debt restructuring.

Holdout investors buying the marginal class

When deciding whether to buy SBBS or national bonds, prospective holdouts face a trade-off between a "vote multiplier" effect and a "dilution" effect. The "vote multiplier" effect refers to holdout investors obtaining de facto voting rights pertaining to the entire structure by buying only the marginal class. The "dilution" effect arises from the fact that investors obtain a claim with a weight of less than one on each underlying bond (given that SBBS are inherently diversified). The trade-off between these two effects implies that:

- **Conditional on the 10%-thick junior security being marginal, holdout investors will prefer to hold bonds directly if the sum of the weights of defaulting countries is below 10%.** This is because the vote multiplier of 1/0.1=10 would be dominated by the dilution effect of less than 0.1, such that one euro of a marginal class holding would acquire less than one euro of de facto voting rights.[34] By contrast, when the weight is greater than 10%, the vote multiplier of 1/0.1=10 would dominate the dilution effect of more than 0.1. In this case, however, it is likely that the mezzanine security would be assigned as the marginal class.[35]

- **Conditional on the mezzanine security being marginal, holdout investors will prefer to hold bonds directly if the sum of the weights of defaulting countries is less than 20%.** This is because the vote multiplier of 1/0.2=5 would be dominated by the dilution effect of less than 0.2. By contrast, when the weight is greater than 20%, holdout investors will prefer to hold the mezzanine security. (When it is greater than 30%, it is likely that senior SBBS would be assigned as the marginal class.)

- **Conditional on senior creditors being marginal, holdout investors will prefer to hold bonds directly if the sum of the weights of defaulting countries is less than 70%.** They would prefer to hold senior SBBS if it is greater than 70%.

Two considerations might make holdout investors unwilling to hold the marginal class even if the above conditions are satisfied. First, there may be uncertainty about the marginal class. If holdout investors get it wrong – for example by buying junior SBBS when mezzanine SBBS transpire as being the marginal class – they will end up with no say in the restructuring procedure. Uncertainty about the marginal class may arise from the number of countries that will commence restructuring proceedings and the expected LGD decided by a judicial panel (if a rule is not used). Second, if a defaulting sovereign fails to honour a "no-vote" in a restructuring process, holdout investors would prefer to hold sovereign bonds directly so that they may pursue aggressive litigation. By contrast, holding SBBS would have no litigation option value, as algorithmic SBBS issuers would have neither the incentive nor the means to pursue such litigation. As such, holdout investors might opt to hold sovereign bonds directly even when the "vote multiplier" effect dominates the "dilution" effect.

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[34] As an example, imagine that the weight of a country subject to debt restructuring is 5%. In this case, the "vote multiplier" is 1/0.1=10, but the dilution multiplier is 0.05, so a one euro holding of junior SBBS would provide the holdout investor with voting rights worth 0.5 euros. As such, holdout investors would prefer to hold the national bond directly.

[35] In fact, if one applies an LGD = 100% rule in the determination of the marginal class, mezzanine (or senior) SBBS would correspond to the marginal class when the weight is greater than 10%.

In addition, an aggressive calibration of the "fixed LGD" approach would reduce the parameter space in which holdouts may prefer to hold SBBS rather than sovereign bonds directly. For example, a rule of LGD = 100% would exclude any case in which the holdout investor would prefer to hold junior SBBS rather than bonds directly, since the vote multiplier of 10 would always be dominated by the dilution multiplier of less than 0.10. Moreover, a rule of LGD = 100% would rule out the possibility of the mezzanine security being assigned as the marginal class when $w \geq 30\%$, thereby restricting the parameter space in which investors may prefer to hold the mezzanine security rather than bonds directly to $20\% < w < 30\%$.

If there is any residual incentive for holdout investors to hold the marginal class of SBBS in certain states of the world, SBBS issuers could generate an additional dilution effect by buying more than one ISIN per country. In this way, the dilution multiplier would be given at the ISIN level rather than the level of the sovereign issuer. For example, if a given SBBS contained two bonds from a given sovereign in equal proportions, the dilution multiplier for that country would be exactly half. In fact, SBBS issuers could be required to hold at least as many ISINs per country as is necessary to ensure that the dilution effect dominates the vote multiplier effect in all states of the world. The disadvantage with this solution is that it may prove to be operationally problematic for SBBS issuers.[36]

2.2.4 Debt modification

Following a debt restructuring event, old bonds are typically exchanged for modified ones with a reduced present value. From the perspective of SBBS, a relevant question is how modified bonds are incorporated into the SBBS cover pool. In the case of a simple nominal haircut to principal or reduction in coupon payments, this problem is trivial: the modified bonds would be included in the SBBS cover pool just as the old bonds had been. The only difference compared with the status quo ante would be that the nominal haircut would activate the relevant provisions in the SBBS contract that specify the cash flow waterfall. With a zero coupon junior SBBS, this cash flow waterfall might only be activated on the final maturity date, since the coupons on mezzanine and senior SBBS would continue to be paid in most states of the world.

A more complex situation would involve present value reduction via maturity extension. Any maturity extension would lengthen the life of the modified sovereign bond beyond that of the original SBBS. What would happen in this case when the SBBS matures? There are two basic options, depending on the severity of the modification.

- **If the restructuring results in a new collateral pool of sufficient value to repay the senior and mezzanine SBBS holders in full when the SBBS contract matures, the only residual claimants would be junior SBBS holders.** As such, the most straightforward arrangement would be to transfer direct ownership of the modified sovereign bonds from SBBS issuers to

[36] A related solution could be to constrain SBBS issuers to buy no more than a fraction of any bond series. This is one of the reasons why the Eurosystem has adopted an issue share limit of 33%, so that it can never attain a blocking minority in any given series. However, unlike the Eurosystem, the marginal class is not a monolithic bloc: it may contain some holdouts and some ordinary investors. Moreover, this does not preclude holdouts holding the marginal class from colluding with holdouts holding the same bond series directly.

junior SBBS holders, in proportion to their claim. In this way, junior SBBS holders would bear all of the extension risk associated with the maturity extension of the restructured sovereign bond, which is consistent with the original creditor hierarchy of the SBBS. An alternative could be for SBBS issuers to attempt to sell the restructured sovereign bonds in the market and to pass to any income from that sale to junior SBBS holders. However, such a large-scale sale could be disruptive and might take place at fire sale discounts. It would therefore be preferable to transfer bond ownership to junior SBBS holders and allow them to decide how best to manage their new portfolio.

- **If senior and/or mezzanine SBBS holders cannot be paid in full when the SBBS contract matures, it would be necessary to maintain the SBBS structure for the residual life of the modified sovereign bond.** Since future recovery is uncertain, this arrangement would be necessary to preserve the original seniority structure. The precise structure of the extended SBBS would depend on the relative size of the residual claims on the original maturity date. Consider, for example, the case in which senior SBBS holders are paid in full and mezzanine SBBS holders receive, say, 95% of their original claim. In this case, the modified SBBS structure would comprise a 9.09%-thick senior SBBS (the residual claim of the old mezzanine security) and a 90.91%-thick junior security (the residual claim of the old junior security that received no payment on the original maturity date). The original SBBS contract would specify the terms of such modification, which could include a zero coupon new junior security in order to preserve intertemporal seniority.

2.2.5 Institutional framework

The scope of the ESM to assist countries with liquidity problems would not be altered by SBBS. The ESM plays an important role in dealing with fiscal crises in the euro area. In the event of liquidity problems, the ESM can provide financial assistance to a Member State that commits to economic and fiscal reforms by implementing an adjustment programme. The ESM Treaty also provides for a Member State's debt sustainability to be assessed as part of the procedure for granting stability support.

A reliable and transparent negotiation process dealing with necessary sovereign debt restructuring would be in the interest of all parties, notably investors, the ESM, Member States and SBBS holders. The restructuring of sovereign debt differs substantially from a private corporate insolvency. For instance, the objective of a sovereign debt restructuring cannot be to liquidate available assets. Rather, the goal is to restore a sustainable financial situation as quickly as possible and on a durable basis. In the euro area, the basic principles governing the responsibility of Member States and financial market participants need to be observed, and a country cannot be forced to implement debt restructuring against its will. Any restructuring would therefore only take place on the basis of an orderly process and the search for compromise. Moreover, any restructuring requires the agreement of creditors in line with the predefined distribution of majority requirements. An orderly, reliable and transparent restructuring would help enhance the negotiation process, contain macroeconomic costs, and ultimately limit the adjustment burden of a debt restructuring. This supports a more reliable risk calculation and contributes to avoiding future sovereign debt crises.

3 Market intelligence

The High-Level Task Force on Safe Assets was mandated by the ESRB General Board to elicit feedback from market participants on SBBS. The engagement with market participants took place in three forms: an industry workshop at the Banque de France on 9 December 2016, a written survey posted on the ESRB website, and a series of meetings and workshops. The Task Force thereby engaged with a plethora of institutions that have a variety of roles in the financial system, ranging from banks and asset managers to central counterparties (CCPs) and credit rating agencies (CRAs). In addition, the Task Force benefited from papers published by researchers, market participants and other stakeholders.[37]

The engagement with market participants was insightful and provided the basis for much of the Task Force's work. In general terms, market participants expressed three distinct categories of views:

- **Those who place significant weight on redenomination risk.** Market participants expressing this view tend to be significantly home-biased.
- **Those who argue for fiscal integration.** These market participants argued for a deep fiscal union, with joint issuance of securities analogous to US Treasuries.
- **Those who embrace pragmatic steps forward.** These market participants focused their comments on technical issues and implications for SBBS design. The most important insights concerned market microstructure, issuance, security design and investor demand.

Much of the feedback reported here stems from the third category, which comprised a large fraction of market participants. However, feedback is also included from the first two categories where relevant.

3.1 Industry workshop at the Banque de France

On 9 December 2016, the ESRB held an industry workshop on SBBS, hosted by the Banque de France. The purpose of the workshop was to discuss the feasibility of creating a market for SBBS. Discussions were held under the Chatham House rule. This summary of proceedings is intended to capture, in anonymised form, the main insights emerging from each session of the workshop.

The workshop revealed a broad range of views on the feasibility of SBBS. Overall, participants underlined the need for deeper financial integration in Europe. There was a mix of views as to

[37] This includes initial contributions to the literature on SBBS, also known as European safe bonds (ESBies), by Brunnermeier et al (2011, 2016, 2017), Garicano and Reichlin (2014) and Corsetti et al (2015, 2015) as well as subsequent assessments by the Scientific Advisory Council to the German Federal Ministry of Finance (2017), Van Riet (2017), DZ Bank (2017), Kraemer (2017), Credit Agricole (2017), Goldman Sachs (2017), Demary and Matthes (2017), JPMorgan (2017), Bofinger, Feld, Schmidt, Schnabel and Wieland (2017), Schneider and Steffen (2017), Vasil (2018), Bénassy-Quéré et al (2018), De Sola Perea et al (2018), Cronin and Dunne (2018), Dunne (2018) and Leandro and Zettelmeyer (2018).

whether SBBS represent the correct product with which to achieve deeper integration: some participants expressed fundamental scepticism, while others thought that a functioning market for the securities could develop under certain conditions.

Several workshop participants referred to Brunnermeier et al (2017), then published only as an ESRB working paper, in their remarks. Participants saw it as a natural reference point, since the paper represents the original inspiration behind the creation of the ESRB High-Level Task Force on Safe Assets. However, the Task Force has in various ways diverged the original thinking put forward in that paper. For example, as explained in Section 4, the Task Force envisages a considerably smaller size of the SBBS market in the early phases of its development than is suggested in the working paper.

Session 1: Motivation

Session participants defined "low-risk" in terms of low liquidity risk, low volatility risk and low default risk. Low-riskiness is therefore a relative concept along these three dimensions. One participant emphasised the importance of low liquidity risk and low volatility risk in (the creation of) low risk assets: while important, low default risk was second-order, in their view. This implies that an SBBS market should be liquid first and foremost. Two participants agreed that a liquid SBBS market could be achieved by announcing a calendar of regular issuance, such that market players would have a reasonable expectation of large volume in the steady state. In addition, SBBS' design should be as simple as possible, such that even relatively unsophisticated investors would be comfortable trading and holding them. Corresponding repo and futures markets would also likely evolve and support liquidity. One participant emphasised the importance of the securities' inclusion in benchmark indexes.

One participant pointed to the role of senior SBBS in generating a benchmark risk-free rate curve for the euro area. Many market players use national curves for discounting. Session participants reported that this exacerbates financial fragmentation, particularly when cross-country spreads are high. Moreover, a full term structure of maturities would help to boost SBBS' market liquidity.

One session participant expressed scepticism regarding low-risk asset scarcity, but also emphasised that Eurobonds, embedding joint liability among Member States, would be preferable to SBBS. In their view, SBBS without joint liability might pose a problem for certain investors reluctant to hold structured products and could send a (negative) signal to markets about the limits of European ambition. There is also a communication challenge related to the new treatment of simple and transparent securitisations and its interaction with a policy announcement pertaining to the development of an SBBS market. On the other hand, a successful SBBS market could help to revive the broader European securitisation market. Nevertheless, the issuance of a new securitised product was seen as challenging in view of the history of these instruments during the financial crisis.

Participants broadly agreed that an SBBS market would need initiation by the public sector, including via:

- **Debt management office (DMO) coordination:** DMOs could coordinate issuance for the fraction of their calendar intended for SBBS.

- **Regulatory treatment:** A necessary condition for the development of an SBBS market would be the application of a "look-through" approach to the regulatory treatment of SBBS, such that they would be treated consistently with the underlying sovereign bonds. Without consistency of treatment, would-be investors would (be forced to) treat SBBS as structured products, in terms of both regulation and their investment mandates, thereby shrinking the potential investor base. For one participant, a regulatory treatment of sovereign bonds that imposed soft or hard concentration charges would encourage marginal portfolio shifts in favour of SBBS. This was deemed preferable to risk-based capital charges.

- **Simplicity:** SBBS should share the characteristics of straightforward fixed income securities. A simple structure – with fixed portfolio weights on the asset side and a maximum of three securities on the liability side – would encourage investors to view SBBS as a bond rather than as a structured product.

- **Liquidity:** The SBBS market should be liquid, including in a build-up phase when volumes are below those in the steady state. Liquidity would be supported by a transparent timetable of SBBS issues, such that investors would have a reasonable expectation of adequate volumes.

- **Restructuring procedure:** Investors need clarity about the implications for SBBS in the event of a sovereign default.

Session 2: Sovereign debt markets

Session 2 participants emphasised the importance of DMOs' objective of minimising borrowing costs to the taxpayer. Part of these costs is due to the liquidity premia paid by DMOs. It is therefore important to minimise liquidity premia by ensuring continued liquidity in existing sovereign debt markets. The SBBS market should therefore be designed in a way that does not impair liquidity in underlying sovereign debt markets. Although one participant emphasised that SBBS would harm price discovery on sovereign debt markets, most thought that a gradual (rather than rapid) development of an SBBS market – initially in "experimental" or "proof of concept" fashion – would be the least disruptive. Gradual development would allow market players and regulators to learn about the impact on secondary market liquidity and calibrate the programme accordingly.[38]

At the same time, Session 2 participants reiterated the main insight of Session 1 about the importance of ensuring SBBS market liquidity. This could be compatible with a slow, experimental approach to market development if investors were to harbour reasonable expectations about the steady-state size of the SBBS market. With a transparent calendar of regular and

[38] In another session, a participant noted that a fraction of the underlying portfolio could be used in repo transactions. This could generate income for the arranger – thereby encouraging new entrants to capture such expected profits – and alleviate collateral scarcity in sovereign bond markets. As such, this proposal could ease concerns about the impact on secondary market liquidity.

moderately sized issuances, several participants expressed confidence that adequate SBBS market liquidity would emerge, aided by the development of functioning repo and futures markets. However, some participants expressed reluctance to establish a regulatory treatment that would be attractive for SBBS while penalising existing sovereign debt.

Participants thought that the most feasible way to gradually introduce an SBBS market would be for DMOs to coordinate on the fraction of issuance that is intended for SBBS, for example by pre-agreeing to execute a (private) placement of their bonds with an SBBS-issuing entity. Moreover, bonds would ideally be homogenous in terms of their characteristics (e.g. maturity, coupon), thereby ensuring commonality of cash flows to the SBBS-issuing entity over its lifetime. According to this view, most bonds would continue to be sold using the existing mix of placements, syndications and auctions. The current market microstructure would therefore persist, thereby limiting the effect of SBBS on secondary market liquidity and ensuring DMO autonomy with respect to the timing and characteristics of the (vast) majority of their issuance calendar.

With regard to market-making activities, one participant said that market-making for senior SBBS might be possible, while market-making for junior SBBS would be more difficult. Moreover, the profitability for market-makers might be lower in the SBBS market than in current national sovereign debt markets.

Session 3: Commercial banks

As in earlier sessions, several participants expressed scepticism about a regulatory regime that would impose risk-based capital charges on sovereign debt. Instead, participants favoured incentives for diversification to alleviate banks' current home bias. SBBS could represent such an incentive for diversification, particularly if coupled with capital charges for concentrated portfolios. At the same time, for some participants home bias represents rational behaviour, aimed at minimising asset-liability mismatches.

In general, participants expected the yield on senior SBBS to have a positive spread with respect to comparable German sovereign bonds, particularly in the early stages of the market when liquidity would be at its thinnest. One participant said that the yield on senior SBBS would most likely be somewhere between the German sovereign bond yield and ESM bond yield.

Several Session 3 participants emphasised the attractiveness of supranational and sub-sovereign debt securities, which offer moderate pick-up in terms of yield for the same regulatory treatment as central government bonds. SBBS could tap into this existing investor base, conditional on regulatory changes that would carve out SBBS from the existing treatment of structured products. An analogy is provided by covered bonds, for which the existence of strong national laws provides the conditions for low spreads. On the other hand, one participant thought that consistent treatment of SBBS relative to the underlying would be insufficient to engineer demand for SBBS. Banks in core countries would still be reluctant to rebalance their portfolios to senior SBBS, whereas banks in vulnerable countries would be reluctant to forgo the high returns expected from holding domestic sovereign debt. In their view, regulators would need to implement a favourable treatment of SBBS (relative to the underlying), but this would have the undesirable side-effect of crowding out demand for the remaining float of national debt.

Several participants argued that a 30%-thick junior security would be too large relative to the size of the potential investor market. In this respect, sub-tranching would reduce the size of the high-yield first loss piece that would need to be placed with investors but would add to the complexity of the product.

One participant highlighted a dilemma by which SBBS issuance would entail a natural monopoly, whereas public sector arrangement of SBBS would in their view imply risk-sharing among Member States. Overcoming this dilemma would require changes to the features of SBBS issuance that otherwise imply natural monopoly. One such change could be coordinated DMO issuance, as suggested in Session 2 of the workshop and discussed in Section 4 of this volume.

Session 4: Non-bank investors

Session 4 participants began by highlighting their reasons for holding sovereign bonds. Several participants pointed to the role of liability-driven investment, which calls for long-dated, fixed income assets. For these buy-and-hold investors, liquidity is less important; what matters instead is low credit risk combined with non-negative returns.

Participants emphasised that the attractiveness of SBBS is a relative value proposition. Investment decisions would be based on SBBS' expected risk/return relative to other investible assets.

- One participant expressed a preference for senior (rather than junior) SBBS, conditional on regulatory reform that would define SBBS as sovereign bonds rather than structured products. To be used as a duration instrument, senior SBBS would ideally need to have a credit rating of AAA, with a moderate pick-up compared with other AAA-rated assets. Transactions costs for trading SBBS would also need to be low.

- Another participant claimed that risk managers would treat SBBS as a securitisation, regardless of the existence of regulation that may define it otherwise. This could impede the extent to which senior SBBS could be used to manage duration risk.

- Another participant claimed that redenomination risk should be considered because it influences ratings and pricing.

- A third participant said that they might hold junior SBBS in (relatively niche) funds that permit holdings of structured products. In their view, senior SBBS would only be held by sovereign bond funds if they were to comprise part of the benchmark against which performance is evaluated. In general, holding senior SBBS in a sovereign bond fund would be difficult or impossible in the absence of changes to the mandates of such funds, which otherwise prohibit holdings of structured products. This would require investors to perceive SBBS as a non-securitised product.

- Two participants claimed that the "maths do not add up" in terms of the likely yield on senior and junior SBBS relative to the underlying. In their view, prospective holders of junior SBBS would require a high return, such that the yield on senior SBBS would be negative in the current interest rate environment.

Session 5: Demand for junior SBBS

Session participants agreed that regulatory change would be necessary to ensure the success of an SBBS market, echoing earlier contributions. One participant noted that, even with regulatory reform, holders of SBBS would continue to bear "regulatory risk" (as the future framework could again be changed to penalise SBBS).

Participants discussed the size of the potential investor base for junior SBBS. One participant said that junior SBBS represents "high octane" sovereign risk and would therefore compare naturally to emerging market sovereign debt. There is an investor base for such risk exposure, but it is relatively niche. Another participant said that investors would evaluate the relative attractiveness (in terms of risk/return) of junior SBBS compared with (high-yield) corporate bonds. This suggests finite investor capacity for high-yield debt instruments. As such, there might be a natural limit on the size of the SBBS market. The point at which this limit is reached could be identified by an incremental approach to growth in the SBBS market.

Several participants expressed concerns about high correlations between the PDs of the underlying sovereign bonds. The unconditional PD is lower than the PD conditional on the default of (other) sovereign bonds. Modelling such conditional probabilities is difficult, however, and subject to considerable parameter uncertainty. Before the crisis, the market had amassed a rich stock of expertise capable of pricing such securities in the presence of parameter uncertainty. While this expertise has now atrophied, it could be revived by an active SBBS market.

One participant noted that collateralised debt obligations (CDOs) require a positive excess spread to generate profits. Some prospective CDOs generate a negative excess spread, and the economics of issuance do not work out for that reason. The same challenge applies to SBBS. To maximise the probability of obtaining a positive excess spread, SBBS arranger(s) could engage in "ratings optimisation" with respect to the design of the securities. This suggests that at least three securities would be warranted (namely first loss, mezzanine and senior). Such investor catering could be done by the market via "re-securitisations", conditional on regulatory reform to accommodate SBBS-squared as well as SBBS.

One participant argued that SBBS could increase sovereign PDs. Default would be less costly insofar as banks rebalance their sovereign portfolios away from their current home-biased holdings in favour of senior SBBS. This might change sovereigns' cost/benefit calculation, as a default would be less destructive for the domestic banking sector and hence for the functioning of the real economy. At the margin, widespread holdings of senior SBBS in the banking sector could make sovereign default more likely.

Session 6: Risk measurement

All participants took a generally conservative approach to risk measurement. In terms of credit risk, this implies an underlying assumption of high correlations during stress events. In terms of liquidity risk, this implies a working assumption of low liquidity until proven otherwise.

Several participants noted that, although correlation among underlying PDs is important for measuring risk, it is difficult to quantify. A conservative approach would assume high

correlations, particularly during times of crisis. In the view of one participant, high correlations would imply that 70%-thick senior SBBS would struggle to achieve the highest credit rating, particularly given that the underlying portfolio is "lumpy" as it comprises bonds issued by 19 sovereigns (so that discrete default events could have large effects). Redenomination risk was also mentioned as a factor in risk measurement.

One participant pointed out that the PD of junior SBBS would be at least as high as the highest PD in the underlying portfolio. Some credit ratings take expected recovery rates into account, such that junior SBBS could benefit from a better rating than that implied by their PD, but recovery rates are subject to a high degree of uncertainty. Another participant emphasised the importance of achieving clarity ex ante on the workout arrangements for junior SBBS in the event of a default on the underlying bonds.

3.2 Meetings with market participants

Task Force members met with market participants to seek their views on technical aspects related to SBBS. Meetings were held with a wide variety of representatives from the financial sector, including numerous investment banks, commercial banks, asset managers, money market funds, insurers, CRAs, CCPs, consultancy firms and DMOs. Market participants demonstrated substantial interest in the Task Force's work and gave meaningful feedback. The main themes of these discussions are summarised here. To protect the integrity and confidentiality of the aforementioned meetings, comments and insights are not attributed to specific persons or firms.

Regulation

Market participants emphasised that SBBS must be treated by regulation in a way that is consistent with the treatment of the underlying. This was seen as necessary by all market participants with whom Task Force members met, as the incentives for creating and buying SBBS would not otherwise exist. Regulatory reform should cover the entire financial system and should not focus only on banks. A dedicated product regulation, which would potentially treat (senior) SBBS like a sovereign bond, was seen by most as an encouraging step forward.

Demand

One of the broadest observations was that asset managers would have restrictions on purchases of SBBS (in the absence of any change in their funds' mandates). Many clients are hesitant to invest in structured products and hence the largest percentage of fixed income funds excludes these from their investible universe. However, it was stressed that if regulation were to define (senior) SBBS like sovereign bonds then clients could perceive them as fixed income products and include them in their portfolio.

Passive investment funds might hold SBBS to track major sovereign bond benchmarks. SBBS would not be included in benchmark indexes directly, as they represent a repackaging of securities that are already included in sovereign bond and other benchmarks. However, passive

investment funds could track such indexes by holding SBBS, as the cash flows accruing to these assets would depend only on the underlying sovereign bonds.

Investor base for subordinated SBBS

Some market participants pointed out that they could not see a natural investor base for the first loss piece. In their view, its risky nature would deter most investors, and there are few market participants whose investment strategy is to trade first loss pieces of securitised sovereign debt. Instead, they envisaged that the product could attract investors who typically deal with other securities with similar risk properties. Examples of such securities include high yield bond funds, structured product investors and emerging market sovereign bond funds. If the SBBS market develops smoothly and investors develop trust in it, an investor base could eventually develop around junior SBBS.

In addition, market participants agreed that the 30% of subordinated securities should be split into mezzanine and junior components. This would in their view induce a wider class of investors (especially insurers) to invest in subordinated SBBS (by purchasing mezzanine SBBS). Without sub-tranching, relatively risk-averse investors would most likely be deterred from holding a subordinated security with first-loss characteristics.

Yield on senior SBBS

Market participants highlighted the potential for substitutability between senior SBBS and German sovereign bonds. Many felt that it would be difficult for senior SBBS to compete with the established pedigree of German bonds as a low-risk asset. Besides credit risk, a key reason why German bonds are currently preferred by investors is due to liquidity, at least according to some market participants. Since it would take some time for senior SBBS to reach the liquidity levels of German government bonds, the senior security would be at a competitive disadvantage during a transition phase. Hence, it is likely that senior SBBS would trade at higher yields than German government bonds. Several market participants compared senior SBBS and debt securities issued by supranational agencies, which indeed trade at small spreads over German government bonds.

Liquidity

Ample liquidity was stressed as being of utmost importance for delivering a well-functioning SBBS market. This was seen as especially true for the senior security. Perception of low credit risk is not enough if the market is illiquid. It was stressed multiple times that credit risk is less important and that investors would be happy to be exposed to more risk if they are guaranteed liquidity.

It was highlighted that, to ensure liquidity, SBBS should be issued in adequate volumes. An adequate supply of securities would need to exist to make an impact in the market, and trading should be uninhibited. Again, some market participants made a comparison with ESM bonds. Furthermore, the volumes should be preannounced well in advance, and issuance should be carried out according to a pre-agreed calendar, so that market participants could anticipate future

events and market size. This strategy is already implemented by issuers of sovereign bonds in the primary market.

Simplicity, transparency and homogeneity were seen as key by market participants to ensure adequate liquidity of SBBS. Simplicity and transparency would help to deliver greater demand for SBBS from a wider class of investors. Homogeneity was also seen as important for that. In addition, the combination of these three attributes would help to ensure sufficient liquidity in the market.

Incremental development of the market

Most market participants were of the view that it would be best to incrementally develop the market. This would be beneficial on several fronts. First, it would help to build a liquid market as investors could form expectations regarding the likely growth in market size. Second, it would be small enough so as not to crowd out sovereign bond market liquidity, thereby allowing the roll-out of an SBBS issuance programme to be reversed if necessary. Third, for many of the potential buyers of senior SBBS, a lead-in period would be needed so that they could fully study and understand these new assets and gain stakeholder approval to purchase them. Investment mandates might have to be changed in many instances, and a period of client education would likely be required.

Public versus private arrangement

Many market participants voiced the opinion that it would be advantageous if the arranger were a public body. First, it would help with demand as it would provide assurance to investors that SBBS have the intended risk properties. Second, public sector arrangement would provide greater certainty that the securities would be regularly issued, aiding liquidity. Third, a public body might be more capable of dealing with warehousing costs. Furthermore, if there were multiple private arrangers, the homogeneity of the product could be hampered.

However, private sector arrangement was not excluded by survey respondents; it was only seen as operationally and logistically more difficult to achieve. Hybrid approaches could also be envisaged. For example, one participant mentioned that it would be best if the assets were on the balance sheet of a private institution with a public body acting as the arranger.

DMO coordination

The idea that SBBS arranger(s) should source the underlying portfolio from the primary market (e.g. via private placement) with the help of dedicated DMO coordination was appreciated by market participants. First, it would alleviate the issue of sourcing the bonds from the secondary market, which they considered operationally challenging, although not impossible. Second, it would mitigate much of the warehousing risk and costs associated with issuance. Third, depending on the degree of coordination, it would help with ensuring homogeneity and high levels of liquidity. Overall, DMO coordination would significantly reduce costs to arranger(s) and help to support market liquidity.

One market participant insisted that a rolling programme would do away with the need for DMO coordination, which would make issuance rigid. In their view, the best solution would be to have dynamic issuance, with the pool being assembled in the markets. Trading would be frequent in order to match the maturities of SBBS and the underlying sovereign bonds.

Collateral eligibility and repo markets

It was seen as a necessary precondition that senior SBBS would be eligible for placement as collateral at the ECB. If that did not happen, sovereign bonds would gain a significant competitive advantage.

In addition, SBBS (at least the senior securities) should also be eligible as collateral in repo transactions. This would help promote market liquidity and could add some advantage over German government bonds. One market participant pointed out that German bonds are not widely available, and that scarcity causes problems in cash and repo markets. Some participants stressed that the SBBS-issuing entity should be able to lend out the underlying. This would help the entity run a profitable operation. It would also alleviate collateral scarcity.

Risk measurement

SBBS were seen as an ambiguous asset class as they entail elements of both sovereign bonds and structured products. CRAs gave insights to their approach to assigning credit ratings to SBBS. One agency said that it would simulate losses in the underlying portfolio and then compare the resulting ELs to standardised tables to determine the credit rating of the securities. Another agency would use a PD approach, assuming 100% LGD for all countries.

Many participants agreed that the success of SBBS does not depend on senior SBBS obtaining a credit rating of AAA. Investors' perceptions of the risk properties of senior SBBS might be the same even if they were AA-rated. For example, bonds issued by the United States and France were widely perceived as low-risk investments, despite having a credit rating just below AAA.

Some participants were concerned about what would happen to SBBS holders if euro area countries were to redenominate in a new national currency. Since the project does not imply fiscal mutualisation, they felt that if the risk materialised, SBBS holders would lose value (due to the presumed exchange rate depreciation). As there is no fiscal mutualisation or implicit guarantee associated with SBBS, they feared that this added a significant dimension of risk to the product. It should be noted, however, that one CRA mentioned that it would not explicitly examine redenomination risk in its modelling.

Shortage of low-risk assets

Most participants seemed to agree that there is a partial shortage of low-risk assets in European markets. Some felt that there is a genuine need for a union wide low-risk asset, while others felt that scarcity could be attributed to the implementation of monetary policy. A minority was

of the opinion that supply and demand dynamics are such that the market always clears, making low-risk assets a matter of price and yield.

Other insights

- SBBS should be issued along the curve, with a focus on long-term maturities.
- SBBS' characteristics should be as divergent from a typical CDO product as possible. An issuance process similar to that of off-balance-sheet covered bonds should be considered.
- There was some concern that an EU product regulation might not be reciprocated by other jurisdictions.
- Hedge funds could eliminate the excess spread by replicating and shorting. The no arbitrage condition is likely to hold.
- SBBS would open up the euro area to new market segments and increase demand among global investors. From a global perspective, an SBBS programme would be "momentous" (in the words of a senior manager at one of the largest asset managers).
- Consideration should be given to the legal jurisdiction governing SBBS.
- Money market funds would be one of the largest categories of buyers of senior SBBS at maturities of less than 190 days.
- A possible introduction of dynamic credit enhancement, where the subordination level is adjusted in stress times, could help with demand.

3.3 Survey

The High-Level Task Force on Safe Assets ran a survey to consult market participants on various open questions on the possible implementation of SBBS. The questionnaire sought feedback on key issues identified by the Task Force, as well as concerns that were raised in bilateral market intelligence meetings. The survey was published on the ESRB website on 22 December 2016 and closed on 27 January 2017.

The survey received responses from four investment banks, three commercial banks, four asset managers, three investment funds and one CCP. Overall, the responses were in line with feedback that Task Force members received in meetings, but some new insights also emerged (such as the expectations for credit ratings that would be assigned to senior SBBS). A breakdown of responses and conclusions drawn from the survey is provided below.

3.3.1 Senior SBBS

To what extent do you perceive a shortage of low-risk and highly liquid euro assets?

Respondents' views about the supply of low-risk assets were mixed. While a majority reported a partial shortage of low-risk assets, the responses also suggest ambiguity regarding the severity of the problem as survey respondents perceived it.

Answer breakdown:

2 felt that there is considerable shortage

8 felt there is partial shortage

4 did not believe that there is a shortage of low-risk assets. In particular, one respondent highlighted that there is "no shortage in terms of availability – the price is just high, but low-risk and highly liquid assets can always be purchased".

1 did not answer

In which asset class would you categorise senior SBBS?

There appears to be a division among market participants as to the classification of SBBS. This is consistent with feedback received at the Banque de France workshop and in bilateral meetings, where participants admitted that they could see arguments for SBBS being classified either as a bond or as a structured product. One respondent noted that, for senior SBBS to be classified as a government bond, the security would need to meet structural ("fixed rate, bullet nominal"), regulatory ("ECB collateral, solvency capital for banks and insurance equal to government bonds") and market transparency ("rules of issuance, timing") requirements.

Answer breakdown:

6 perceived it as a government/supranational bond only

6 perceived it as a structured product only

3 perceived as both a bond and a structured product

There are several ways to measure credit risk. How would you score these different risk measures in terms of their usefulness for evaluating the properties of senior SBBS?

	Very useful	Useful	Partly useful	Not useful	No answer
Probability of default (PD)	7	4	0	0	4
Expected loss (EL)	7	3	1	0	4
Value-at-risk (VaR)	4	6	2	0	3
Expected shortfall (ES)	3	4	2	0	6
Marginal expected shortfall (MES)	1	4	1	1	8
CoVaR	2	4	1	0	8

In addition, two respondents indicated that different risk metrics to the ones above would be useful. Specifically, one respondent referred to the relationship between SBBS and the euro swap rate. The other suggested to “stress loss under extreme but plausible market conditions” and default correlations. Another indicated that “markets would probably price this on an expected loss basis (CDO-type pricing)”.

What spread (in basis points) would you expect in the yield-to-maturity of 10-year senior SBBS relative to 10-year benchmark German sovereign bonds? If possible, specify the precise expected spread in the free text box.

Answer breakdown:

1 between -50 basis points and 0 basis points

7 between 0 basis points and 50 basis points

4 between 50 basis points and 100 basis points

3 did not answer

Which long-term credit rating would you expect to be assigned to senior SBBS?

At the Banque de France workshop, several participants expressed doubts that senior SBBS could achieve a credit rating of AAA. However, most survey respondents felt that senior SBBS would be rated AAA, with the rest expecting the second-highest rating notch.

Answer breakdown:

8 AAA

7 AA

Low-risk assets typically appreciate in value during periods of stress. If perceived sovereign risk were to increase, would you expect the value of senior SBBS to increase, stay the same, or decrease?

Analysis presented in Section 1 indicates that there is negative correlation between the yields on SBBS of different riskiness in periods of financial stress. Risk-averse investors seek haven in low-risk assets, given rise to relative price movements within the SBBS structure. However, respondents to the survey were divided as to whether these flight-to-safety price dynamics would materialise in practice.

Answer breakdown:

6 increase

6 decrease

3 did not answer

How important is the liquidity of senior SBBS?

Respondents perceived the liquidity of senior SBBS as "very important". This is in line with the feedback perceived in bilateral meetings and at the Banque de France workshop.

Answer breakdown:

13 very important

2 did not answer

To ensure adequate liquidity of senior SBBS, which categories of maturities would need to be issued?

There seemed to be a slight preference from respondents for the term structure of SBBS to cover the most liquid points as opposed to the entire curve.

Answer breakdown:

6 issuance at most liquid points of the curve

5 issuance at all points of the curve (from the very short to the very long end)

4 did not answer

To ensure adequate liquidity of senior SBBS, to what extent is it important for them to be highly standardised? Or could there be some degree of flexibility (e.g. regarding portfolio weights)?

Respondents preferred a high level of standardisation, reflecting the importance of homogeneity across different SBBS series.

Answer breakdown:

9 high standardisation – the prospectus should fix portfolio weights with no scope for deviation

4 medium standardisation – the prospectus should allow only limited deviation (within a small min/max range)

2 did not answer

What is the minimum total notional value of senior SBBS necessary to ensure adequate liquidity?

Respondents did not seem to agree on an exact figure, but the consensus was that the notional should be relatively high. Specifically, most agreed that any size below €250 billion would not result in a sufficiently liquid market, although several participants did not answer this question.

Answer breakdown:

2 more than €1,500 billion

1 between €1,000 and €1,250 billion

2 between €500 and €750 billion

2 between €250 and €500 billion

2 less than €200 billion

6 did not answer

What is the minimum monthly issuance of senior SBBS (in terms of notional value) necessary to ensure adequate liquidity?

Similar to the previous question, there was no agreement on the volume of monthly issuance that could ensure adequate liquidity. From the responses, it seems that a target around the €10 billion mark could suffice. A relatively high number of participants did not answer this question.

Answer breakdown:

1 more than €20 billion

2 between €15 billion and €20 billion

4 between €10 billion and €15 billion

2 between €5 billion and €10 billion

1 less than €5 billion

5 did not answer

Why might your institution hold senior SBBS?

	Responses
Asset-liability management (of maturity mismatch)	5
Collateral	8
Investment return	4
Liability-driven investment	2
Liquid store of value	9
Regulatory requirements	7
Low-risk store of value	4

Assuming that senior SBBS are designed such that they meet your requirements in terms of credit and liquidity risk, what percentage of your institution's current holdings of central government debt could be replaced by senior SBBS?

Overall, it seems that substitutability would be quite low in absolute values, which is consistent with an incremental approach to SBBS market development. Responses to the survey indicate that institutions would be willing to substitute, on average, around 10% of their holdings with SBBS. However, a high number of participants did not answer this question.

Answer breakdown:

1 more than 100%

1 90-100%

1 20-30%

2 10-20%

2 0-10%

8 did not answer

3.3.2 Junior SBBS

In which asset class would you categorise junior SBBS?

Respondents expressed different views on the classification of junior SBBS as opposed to senior SBBS. Many indicated that the senior security could be classified as a bond but thought that the junior securities would be seen as a structured product. This divergence in perception is likely to have arisen due to the different risk properties of the two securities. More risk-averse market participants are hesitant to see junior SBBS being treated like a bond (either in regulation or as an investment), even though their level of transparency is the same as senior SBBS. Nevertheless, one respondent noted that that junior, like senior, SBBS could be perceived as a bond as long as structural, regulatory and market transparency rules are satisfied (see the same question for senior SBBS above).

Answer breakdown:

3 bond only

8 structured product only

2 both bond and structured product

2 did not answer

There are several ways to measure credit risk. How would you score these different risk measures in terms of their usefulness for evaluating the properties of junior SBBS?

	Very useful	Useful	Partly useful	Not useful	No answer
Probability of default (PD)	6	3	0	0	5
Expected loss (EL)	5	4	0	0	5
Value-at-risk (VaR)	4	3	1	0	6
Expected shortfall (ES)	3	3	0	0	8
Marginal expected shortfall (MES)	2	2	0	1	9
CoVaR	2	1	2	0	9

In addition, one respondent indicated that different risk metrics to the ones above would be useful: “stress loss under extreme but plausible market conditions” and default correlations.

Also, one respondent indicated that “markets would probably price this on an expected loss basis (CDO-type pricing)”.

Which long-term credit rating would you expect to be assigned to junior SBBS?

7 respondents indicated a non-investment grade rating, while 8 felt that the junior security would be given a maximum rating of BBB.

What spread (in basis points) would you expect in the yield-to-maturity of 10-year junior SBBS relative to 10-year benchmark German sovereign bonds? If possible, specify the precise expected spread in the free text box.

A relatively high number of participants did not answer this question.

Answer breakdown:

2 more than 300 basis points

3 between 200 basis points and 300 basis points

3 between 100 basis points and 200 basis points

1 other: “this would depend on the credit rating and the underlying structure of these products”.

6 did not answer

Any mispricing between the replicating portfolio of junior and senior SBBS and the underlying portfolio could in principle be arbitraged away. To what extent would you expect such arbitrage to take place?

Most respondents seemed to agree that there would be some excess spread. Its size was debated, but the key insight here is that respondents expected an excess spread to exist. A relatively high number of participants did not answer this question.

Answer breakdown:

4 negligible arbitrage, excess spread would be significant

5 some arbitrage, excess spread would be small

1 significant arbitrage, excess spread would be negligible

5 did not answer

Would a contractual unbundling option – whereby an investor holding a replicating portfolio of junior and senior SBBS could swap that portfolio for the underlying sovereign bonds – facilitate arbitrage?

Respondents seemed to agree that unbundling would facilitate arbitrage, albeit to varying degrees. A relatively high number of participants did not answer this question.

Answer breakdown:

2 yes, unbundling option is critical for arbitrage to work

3 yes, but arbitrage will work even without the unbundling option

2 somewhat but other frictions would still prevent full arbitrage

1 no, unbundling option would not work, and arbitrage will be limited

7 did not answer

Would junior SBBS' property of embedded leverage enhance their attractiveness in terms of expected return?

There seemed to be agreement that the embedded leverage property of SBBS could play a role in attracting higher demand. A high number of participants did not answer this question.

Answer breakdown:

2 certainly yes

4 probably yes

1 maybe

8 did not answer

Would sub-tranching junior SBBS, for example in the form of a 15%-thick tranche of junior SBBS and a 15%-thick tranche of mezzanine SBBS, enhance total demand for the securities?

Responses were consistent with market intelligence meetings, where market participants showed more willingness to invest in a mezzanine security rather than a 30%-thick first loss piece.

Answer breakdown:

2 certainly yes

6 probably yes

2 maybe

2 probably no

3 did not answer

One of the respondents answering "probably no" provided further clarification in the free text field. While they believed that a mezzanine layer could enlarge the potential investor base, they thought that this might reduce demand for the smaller and therefore riskier junior security. On the other hand, they asserted that a mezzanine security would be eligible for amortised cost treatment under IFRS 9, since it would receive credit protection from junior SBBS.

How important is the liquidity of junior SBBS?

Respondents felt that the liquidity of junior SBBS is important, but not to the same extent as for senior SBBS.

Answer breakdown:

5 very important

4 important

1 neutral

1 not important

4 did not answer

To ensure adequate liquidity of junior SBBS, to what extent is it important for them to be highly standardised in a master prospectus? Or could there be some degree of flexibility (e.g. regarding portfolio weights)?

Similar to senior SBBS, survey respondents reported that there is a lot of merit in having a high degree of homogeneity among different SBBS series.

Answer breakdown:

7 high standardisation – the prospectus should fix portfolio weights with no scope for deviation

2 medium standardisation – the prospectus should allow only limited deviation (within a small min/max range)

6 did not answer

Why might your institution hold junior SBBS?

	Responses
Asset-liability management (of maturity mismatch)	0
Collateral	2 (provided it is accepted by the ECB)
Investment return	6
Liability-driven investment	0
Liquid store of value	1
Regulatory requirements	1
Low-risk store of value	1

Other reasons given include market-making and hedging. One investment fund and one CCP indicated that junior SBBS would not be eligible for them to hold.

Assuming that junior SBBS are designed such that they meet your requirements in terms of credit and liquidity risk, what percentage of your institution's current holdings of central government debt could be replaced by junior SBBS?

Respondents mentioned a low degree of substitutability (expected given the different nature and perception of junior SBBS relative to central government bonds). A high number of participants did not answer this question.

Answer breakdown:

1 10-20%

2 0-10%

2 0%

10 did not answer

What changes to the design of junior SBBS would make them more attractive?

Some respondents felt that junior SBBS would not offer enough return to motivate substantial investment. The feedback received from responses to the open question was that additional buffers are needed to protect against the risk exposure. Some proposals included:

- "A third tranche."
- "A 5% equity tranche placed at the ESM (with partial corresponding reduction of the Greece programme) should be introduced."
- "Public issuance and guarantee."

- "Over-collateralisation."
- "Ensure bullet nominal structure by an exact matching of capital redemption for bond constituents and SBBS, and a similar timing for the issuance of the SBBS and the bond constituents. Also, a fixed rate bond requires a good certainty of coupon payments. If the bonds are paying different coupons at different payment dates, best would be to have a small coupon to ensure good coupon coverage and certainty, with a mechanism to deal with excess spread, and some adjustment of the issue price to adjust junior SBBS yield."

3.3.3 Regulation

What areas of regulation currently disincentivise the development of SBBS? Explain your answer in the free text field.

Area of regulation	Yes	Comments
Capital regulation for banks	5	"0% risk weight necessary" "Large exposure limits, leverage ratio, capital requirements" "They are a structured product"
Liquidity regulation for banks	5	"HQLA eligibility is key for banks" "LCR" "Would need 100% liquidity against them" "SBBS should be LCR eligible"
Insurance regulation	2	"Solvency 2"
Investment fund regulation	1	
Pension fund regulation	1	
Capital bank collateral eligibility	3	"Eligibility as collateral by the ECB is key for banks" "SBBS should be an eligible asset with a haircut corresponding to its reduced risk"
Other	3	"All regulation types should adjust to these instruments for acceptance as collateral or low-risk assets" "Index rules and guidelines" "Individual sovereign risks can be accessed through present markets. Little value in bundling risks without sharing them."

Other comments:

- "We do not support a change in the current banking regulation for sovereign exposures. Nevertheless, we consider that the success of senior SBBS would somehow be linked to this regulatory change in the underlying assets."
- "Solvency capital requirements for banks and insurance holding the SBBS should be similar to those of government bonds: no capital charge, no securitisation treatment, no concentration risk."

In your opinion, in the regulatory framework, should SBBS be treated according to …?

Responses to the question were strongly in favour of the look-through approach.

Answer breakdown:

10 look-through approach (two emphasised that it should receive a 0% risk weight even with RTSE reform)

3 current regulation on securitised products

2 did not answer

How should voting rights be allocated?

Respondents concluded that voting rights should be allocated according to investors' holdings. A high number of participants did not answer this question.

Answer breakdown:

3 voting rights should be transferred to investors in proportion to their holdings of junior and senior SBBS

1 voting rights should be transferred to investors in proportion to their holdings of senior SBBS

1 voting rights should be concentrated in the issuing entity

10 did not answer

In addition, 1 respondent commented that "a trustee should handle the voting rights and represent the noteholders".

What other considerations should inform the design of a regulatory framework for SBBS?

Answers:

- "EMIR regulation change to allow recognition of full portfolio margining benefits on SBBS."
- "A guaranteed repo market or liquidity provider available to exchange SBBS for cash to post as collateral for variation margin under centrally cleared swaps would be highly important to us."
- "If they are anything other than pari-passu with governments from a regulatory perspective the project will not work. Likely there will have to be a relative advantage to hold them, to encourage the market initially."
- "The success of senior SBBS is conditional to its regulatory treatment in banking, insurance and pension fund regulation. For senior SBBS, special treatment should be granted in the following areas:

- Credit risk: senior SBBS should not follow the current regulation for securitised products. Instead, they should receive a 0% risk weight that reflects their condition as a risk-free asset.
- Liquidity risk: senior SBBS need to be recognised as a high quality liquid asset, so that they are eligible to comply with the liquidity coverage ratio.
- Market risk: In line with credit and liquidity risk, senior SBBS should also keep the preferential treatment that now is granted for national sovereign debt.
- Moreover, and to reflect the own nature of senior SBBS as a diversified asset, they should be exempted from the large exposure limit.
- Finally, it is also necessary that they are recognised by the ECB as collateral for monetary policy operations and also by CCPs in market operations.

It is necessary to consider that the previous regulatory adjustment would need a greater one, which is the change of the current regulatory treatment of the underlying assets, that is to say national sovereign exposures. This potential change would come with great challenges itself and should be designed and implemented globally, to avoid creating an un-levelled playing field across jurisdictions."

3.3.4 Economics of SBBS issuance

What are the reasons for the current non-existence of SBBS?

Feedback from market intelligence meetings stressed that regulation has been the main impediment to the development of an SBBS market. In addition, respondents cited various other reasons that have not been considered so far.

Answer breakdown:

2 the regulation of both sovereign bonds and securitised products

5 the regulation of securitised products

1 the regulation of sovereign bonds

3 other

4 did not answer

In addition, other reasons were cited in the free text field:

- structuring costs
- warehousing and execution risks
- high degree of complexity

- 2 respondents felt that the sum of its parts has little to offer compared to the individual components
- 1 indicated that “until now there was not a perceived market shortage of low-risk and highly liquid assets, so there was no need of SBBS under the current regulatory framework”.

What would be the most significant operational fixed and variable costs related to SBBS issuance?

Cost type	Yes
Special servicer fees	2
Trading costs	2
Credit rating fees	2
Legal costs	2
Administrative costs	2
Costs related to funding the warehouse	2

In addition, respondents provided the following comments in the free text field:

- Capital cost / balance sheet use (return on equity).
- Regulatory burden of holding.
- Similar to that of exchange-traded funds (those above and observability).

One respondent believed that “issuance costs (rating, servicer, administrative, legal costs) are probably minimal given the size expected”.

Would it be most practicable for assembly of the underlying portfolio to take place via purchases of central government bonds on the primary markets, purchases on the secondary markets, or by using existing portfolios?

Respondents did not indicate that purchasing sovereign bonds on primary markets is necessary for a successful issuance programme. This suggests that DMO coordination would not be necessary for the issuance of SBBS. In addition, one respondent noted that the secondary market could be used to recycle the bonds that the Eurosystem already holds under its PSPP.

Answer breakdown (multiple choices were possible):

7 purchases from the primary market

3 purchases from the secondary market

3 use existing portfolios

3 cannot know

2 did not answer

Given the current characteristics of primary and secondary government bond markets, would it be feasible to assemble the underlying portfolio and place all of the corresponding senior and junior SBBS within one week, using all available technical devices (e.g. advanced book-building)?

Most felt that it would be possible to assemble the underlying portfolio within one week. This implies that portfolio assembly may not be a significant impediment facing arranger(s).

Answer breakdown:

1 yes

3 probably yes

2 probably not

3 cannot know

6 did not answer

It is worth noting that none of those who answered "probably not" felt that warehousing represents a significant cost. Of the two respondents who answered "cannot know", one thought that such a cost would be recouped by revenues, while the other believed that warehousing represents a significant cost.

To what extent would coordinated DMO issuance in the primary market help to alleviate this warehousing problem?

Respondents agreed that DMO coordination would help alleviate the warehousing problem. A high number of participants did not answer this question, however.

Answer breakdown:

3 significant alleviation

2 partial alleviation

1 not relevant or necessary, as the warehousing problem is anyway minimal

9 did not answer

In view of the likely fixed and variable cost structure of SBBS issuance, how many different SBBS arrangers do you expect that the market could sustain in equilibrium?

Respondents did not feel that the market could sustain many arrangers. A high number of participants did not answer this question.

Answer breakdown:

2 two to five arrangers

5 one arranger

8 did not answer

Could SBBS issuance be a profitable operation? Explain your answer in the free text field.

Most respondents did not provide a definitive answer, but some positive feedback was received. In the free text field, four respondents reported that SBBS issuance would be a profitable operation if certain conditions were met.

Answer breakdown:

2 yes ("The consolidated yield on SBBS could in the end become more attractive than the yield combination of the underlying components, provided the product structuring is made in a way to drive the market to consider those products as standalone credits rather than structured products (hence one single public issuing entity, high standardisation, large volumes by issue (benchmark and taps), dedicated DMO issues to avoid duration mismatch costs, warehousing costs, complexity, and capacity to build exact same portfolio for arbitrages.")

2 probably yes ("trading spreads and short term funding profits of unsold bonds")

6 cannot know

5 did not answer

Who should arrange and service the issuing entity?

Respondents favoured a public entity issuing SBBS. This result is in line with feedback in other fora, where investors stated that they would prefer some form of public guarantee. Even if SBBS were on the balance sheet of a privately owned institution, any involvement of a public entity would provide assurance.

Answer breakdown:

9 public sector entity

1 public-private entity

5 did not answer

Insofar as the issuing entity is arranged by private sector entities, would these private sector entities necessarily be primary dealers on sovereign debt markets, or could other types of entities do the job?

Respondents seemed to agree that primary dealers should be arranging the SBBS-issuing entity. A high number of participants did not answer this question.

Answer breakdown:

5 yes – primary dealers have a natural advantage in arranging SBBS issuing entities

2 no – SBBS issuing entities could be arranged by other financial institutions as well as (or instead of) primary dealers

8 did not answer

Would your institution consider becoming an SBBS arranger?

Most institutions that answered the survey do not have experience as primary dealers, so it is unlikely that they would engage in SBBS arrangement. Those institutions that would consider arranging the securities would do so only if regulation were amenable and investors demonstrated enough demand. One respondent stated that their institution would consider arranging SBBS. Another indicated that they would consider being market-makers for SBBS.

Answer breakdown:

1 yes

7 no

3 under certain conditions

4 did not answer

What changes in the regulatory or market environment would make SBBS issuance more attractive?

Most responses hinted at the importance of changing the regulatory regime. Specific comments included:

- "Promote them above ordinary derivatives through regulation."
- "Lower regulatory capital cost."
- "Pari passu or better ranking versus euro area government bonds."
- "Look-through acceptability, not considered as securitisation."
- "We consider that the success of senior SBBS is conditional to their regulatory treatment (they should receive a beneficial treatment in terms of credit, market and liquidity risk and in terms of large exposure limits) and to the regulatory treatment of the underlying assets. Moreover, they should be recognised by the ECB as collateral for monetary policy operations and also by CCPs for market operations. Nevertheless, we consider it key that any changes need to be implemented at one time. Europe cannot afford to be stuck half-way in the implementation process of such a change."
- "Change in the design of the risk, effective liquidity in the market for SBBS which suppose there is a real need for this product among the investors."
- "Arbitrage-free haircuts of SBBS and bond constituents, similar liquidity of SBBS and constituents."

What do you expect to be the likely impact of SBBS on market conditions for sovereign bonds?

This was an open question and a single conclusion cannot be drawn. There were mixed responses, with many assuming a negative impact. All responses are given below.

- "It depends on their popularity and demand. I am sceptical that they will become a large portion of the market."
- "Less sovereign bonds direct issuance."
- "Less supply, but also less demand, possibly leading to difficulty establishing a liquid curve for some [sovereign] issuers."
- "Negative impact on spreads and liquidity on some of the underlying sovereign bonds."
- "In theory if they are successful then government bond liquidity will decline as more bonds go into SBBS. Market determination of intra-EMU spreads will be challenging as they will reflect liquidity more than fundamentals."
- "With the introduction of SBBS as a new asset class, the current void in the middle of the European sovereign debt market spectrum would be filled."
- "Very limited, if issuance came from publicly held debt."
- "If successful, they would extract attractive reserve assets but may reduce liquidity in individual country eurozone bonds."
- "We think that it is likely that for some countries, the expected sovereign issuances are higher than their participation in senior SBBS, leaving a remaining pool of national debt in national sovereign bond markets. The implicit reduction of these markets will have significant negative consequences for sovereign debt not included in the pool for senior SBBS. These bonds will face a sharp decrease in its liquidity, increasing liquidity the premia and negatively affecting the operations in these markets, with increased transaction costs. A solution needs to be foreseen for these types of situations."
- "It depends on the SBBS reaching the level where they are liquid."
- "SBBS would contribute to the emergence of a harmonised EU sovereign bond market, with some mutualisation achieved through structural features rather than policy making."

3.4 Input from representatives of debt management offices (DMOs)

The Task Force exchanged views with DMOs, which were also represented in the Task Force membership. The purpose of these conversations was to garner insights from DMOs regarding potential features of the SBBS issuance process together with the opportunities and challenges that such issuance would represent for sovereign debt markets, including their liquidity and the efficiency of price formation. This section summarises the insights gained from these conversations.

In summary, DMOs view aspects of SBBS issuance as potentially problematic for the implementation of their mandates. On this basis, the section indicates how the various concerns expressed by DMOs in their conversations with the Task Force could help to inform the appropriate security design of SBBS, the development of a market for the securities and the calibration of a possible SBBS-specific enabling regulation.

Guiding principles of DMOs and their current market approach

DMOs generally adopt the following guiding principles of their mandate, which inform the conduct of their market operations. First, DMOs manage their primary market issuance with the aim of minimising borrowing costs, subject to risk management, for their respective governments. Insofar as this objective is achieved, governments can enjoy generally low average borrowing costs over time, thereby helping to support their budgetary decisions. In their conversations with the Task Force, DMOs emphasised that they considered the fulfilment of this "funding cost minimisation" objective to be vital for their credibility. Second, DMOs seek to create an appropriate level of transparency for investors in terms of pricing and market access conditions. This helps to ensure that investors face a level playing field when operating in primary sovereign debt markets.

From the perspective of DMOs, the potential issuance of SBBS, and its implications for sovereign debt markets, should be evaluated in the light of the principles that guide their market operations. In the view of DMOs, certain SBBS issuance models could conflict with the guiding principles of their mandates. They asserted that some models would be particularly disruptive insofar as they would require DMOs to significantly alter their conduct in primary sovereign debt markets, and might therefore be in tension with their key operating principles. The rest of this section describes the nature of these concerns in more detail and provides an indication of how these concerns could help to inform appropriate security design, market development and regulation of SBBS.

Based on these guiding principles, DMOs have established a well-functioning issuance strategy, which has matured over many years of interactions with market participants. As such, the approach of government issuers is well accepted by market participants, in particular to issuance and pricing. The issuance of SBBS could disrupt DMOs' well-established issuance strategy insofar as it would require new behaviour in primary markets. The response of market participants to such disruption is unknown; unless the issuance of SBBS is demand-led, it may have undesirable implications for the smooth functioning of sovereign bond markets.

Concept and rationale of SBBS

In conversations with the Task Force, DMO representatives noted the financial stability rationale for the introduction of SBBS, in particular concerning the bank-sovereign nexus. Nevertheless, DMOs suggested that other policy tools could complement or substitute SBBS by providing appropriate incentives for banks to de-risk and diversify their sovereign exposures. For example, Pillar 3 initiatives targeting enhanced transparency could help to direct market pressure on banks to rebalance their sovereign exposures. According to this view, the disclosure of detailed information on banks' sovereign exposures could provide market-based incentives for banks to

appropriately diversify and de-risk these exposures in a manner that is gradual and therefore does not lead to market disruption.

The design of SBBS is premised on a combination of pooling and tranching, which is also typical of securitisations in other markets. In conversations with the Task Force, DMOs observed that SBBS would invert the typical logic of private sector securitisations, whereby illiquid assets are transformed into more liquid securities, thereby lubricating secondary markets for the underlying risk. By contrast, SBBS would repackage central government debt securities, which in large part are already liquid, since the primary goal of these securities is to provide a mechanism for banks to diversify and de-risk their sovereign bond portfolios rather than to enhance market liquidity. From the perspective of DMOs, the repackaging of liquid central government debt securities could conflict with their objective of maintaining ample liquidity in national sovereign debt markets if the secondary market free float were significantly impaired by the issuance of SBBS. A significant reduction in free float could impair efficient price formation, as explained later in this section and analysed quantitatively in Section 4.

The venue of purchases by SBBS arranger(s)

DMOs expressed concerns about how SBBS arranger(s) purchase sovereign bonds. If purchases were to be made on primary markets, DMOs could be required to adapt their issuance strategy to minimise the warehousing function of SBBS arranger(s). However, primary market coordination would disrupt DMOs' current market approach with respect to issuance timing, which is built around preventing simultaneous issuance of bonds with the same characteristics to limit oversupply and market disturbance. By contrast, if purchases were to be made on secondary markets (or on existing uncoordinated and competitive primary markets), SBBS arranger(s) could represent just another end-buyer for sovereign bonds, as they would compete alongside other prospective investors on equal terms. Under the latter issuance model, there would be limited impact on DMOs' behaviour in primary markets, but at the disadvantage of requiring SBBS arranger(s) to temporarily fund a warehouse of sovereign bonds while the cover pool is assembled.

Primary market purchases by SBBS arranger(s)

The Task Force envisages three possible ways for SBBS arranger(s) to purchase sovereign bonds in primary markets. First, SBBS arranger(s) could purchase sovereign bonds in competitive auctions or syndications, the timing and characteristics of which would be coordinated across DMOs to facilitate the speedy assembly of SBBS cover pools by arranger(s). Second, SBBS arranger(s) could purchase sovereign bonds privately from DMOs (at prices inferred from secondary markets), by DMOs either creating new SBBS-specific ISINs or tapping existing ISINs and allocating those taps to SBBS arranger(s). Third, SBBS arranger(s) could place market orders for sovereign bonds in ordinary competitive auctions or syndications, which as now would not be coordinated across countries in terms of timing or bond characteristics. DMOs attach varying levels of concern to the implications for their mandates of each of these three possible methods of SBBS cover pool assembly, as described in more detail below.

First, DMOs highlighted two major implementation issues regarding primary market purchases via coordinated auctions or syndications. An SBBS issuance model of coordinated

syndications or auctions implies that DMOs would supply sovereign bonds to the market simultaneously. This model is viewed by DMOs as creating market risk, which could put upward pressure on bond yields at issuance depending on the volume of new securities that are issued simultaneously. At present, DMOs generally avoid issuing their debt securities simultaneously to avoid placement risks arising from an excessive supply of new debt securities. Second, coordination would constrain governments' flexibility on the timing and characteristics of their new debt issuance, which DMOs view as necessary to obtain the best possible financing conditions. The quantitative importance of this constraint is analysed in Section 4.

Second, regarding primary market purchases via private placements to SBBS arranger(s), DMOs noted that this option would mitigate concerns about a lumpy supply of sovereign bonds to primary markets, but pointed out other potential drawbacks. DMOs raised particular concerns about the idea of SBBS-specific ISINs to be simultaneously issued and privately placed with SBBS arranger(s), as these instruments would not be traded and therefore must be priced "off-market" like existing private placements. This would be challenging insofar as the volume of these private placements would diminish the issuance of regular securities, the trading of which provides the benchmark against which private placements are priced. To mitigate these concerns, DMOs could instead tap existing issuances and allocate those taps to SBBS arranger(s). From the perspective of DMOs, the benefit of tapping existing bonds is that the allocated taps would be made liquid by the active trading of these bonds in secondary markets. As such, they would be easier to price and could also be used in repo operations by SBBS issuers insofar as operations would be compatible with the robotic nature of these entities. Notwithstanding these potential advantages, DMOs expressed concerns that allocating taps of existing bonds to SBBS arranger(s) could impair the level playing field for investors by disadvantaging primary dealers and other investors without access to these taps, unless primary dealers and SBBS arranger(s) overlapped (as in the case of private sector arrangement). To mitigate this potential problem, DMOs could elect to open such taps to other investors, on the same terms as SBBS arranger(s), to provide the level playing field that is important for efficient price formation. However, DMOs would still need to coordinate the timing of these taps, which at the margin would constrain national discretion on the timing of issuances, albeit to a lesser extent than under the issuance model outlined in the previous paragraph.

Third, regarding primary market purchases via ordinary auctions or syndications, DMOs welcomed the potential participation by SBBS arranger(s) in these markets insofar as they would act alongside other investors on equal terms, but noted that this issuance model may be disadvantageous for arranger(s) owing to sovereign bond market heterogeneity. From the perspective of DMOs, the main advantage of this issuance model is that it would ensure a level playing field between SBBS arranger(s) and other institutions that are active on primary markets. However, from the perspective of SBBS arranger(s), activity in uncoordinated primary market auctions or syndications could require them to fund a temporary warehouse of sovereign bonds while the SBBS cover pool is assembled. This temporary warehouse would need to be funded by internal or external resources. In the case of a public entity acting as SBBS arranger, these resources would need to be pooled in a way that excludes any uncontrolled mutualisation of sovereign risks. Public arrangement would nevertheless require some limited pooling of Member States' resources, for example in the form of paid-in capital. By contrast, in the case of private sector arrangement, resources could be provided without any pooling of Member States' resources. The downside of this is that private sector funding of temporary warehouses of sovereign bonds

would require remuneration, which would in turn detract from the yields that may be paid to final SBBS investors. Overall, then, an SBBS issuance model with SBBS arranger(s) competing alongside other investors in uncoordinated competitive primary market auctions or syndications would address the concerns that DMOs have about potential disruptions to their primary market operations. At the same time, this model would generate new challenges regarding the funding of temporary warehouses of sovereign bonds. A similar trade-off applies in the case of secondary market purchases by SBBS arranger(s), which is considered next.

Secondary market purchases by SBBS arranger(s)

Rather than operate in primary markets, SBBS arranger(s) could obtain sovereign bonds from secondary markets. In some ways, this has similar features to SBBS arranger(s) purchasing sovereign bonds in ordinary uncoordinated competitive auctions or syndications. As such, many of the considerations mentioned above also apply to secondary market purchases, although the latter would be more remote from DMOs as SBBS arranger(s) would have no direct interaction with them. From the perspective of DMO activity in primary markets, secondary market purchases therefore promise to be less disruptive. Nevertheless, poor orchestration of purchases in the secondary market – particularly if such purchases were concentrated in less liquid segments – would exacerbate pockets of illiquidity. To mitigate this potential problem, SBBS arranger(s) should implement secondary market purchases in a manner that minimises market disruption, as has been done by the Eurosystem in implementing its PSPP.

The downside of secondary market purchases is that SBBS arranger(s) would need to fund temporary warehouses of sovereign bonds while they assemble SBBS cover pools. Secondary market purchases by SBBS arranger(s) would require bonds to be acquired at their market price and in sufficient volumes. This may be challenging in a secondary market that exhibits significant heterogeneity with respect to the characteristics of different ISINs, so that the process of cover pool assembly by SBBS arranger(s) could take some days or even weeks, depending on the availability of certain sovereign bonds. As such, SBBS arranger(s) would need to fund their warehouse of sovereign bonds during this time. SBBS arranger(s) would therefore need access to some resources, with implications for both public and private sector arrangement and the pricing of SBBS.

Sovereign bond market liquidity

DMOs asserted that SBBS would need to attain adequate liquidity and be of sufficient size in order to be accepted by market participants. At the same time, DMOs expressed concerns that a large SBBS market would detract from the liquidity of national sovereign bond markets. This negative liquidity effect arises from the fact that some fraction of outstanding national sovereign bonds would be “trapped” on the asset side of SBBS issuers’ balance sheets. In the absence of any securities lending facility engineered by SBBS issuers, this “freezing effect” could lead to pockets of illiquidity in national sovereign debt markets, which might negatively affect price formation, including on primary markets. This is of serious concern for DMOs, as secondary market liquidity is a key objective in pursuit of their mandate of funding governments at low cost over time. Section 4 of this volume contains a quantitative analysis the “freezing effect”, and points to a potential offsetting

effect, namely the “spillover effect”, whereby some combination of the senior, mezzanine and junior securities could be used as a source of price discovery for national sovereign bonds.

SBBS market development

DMOs highlighted that investor demand for SBBS would depend heavily on the perceived risk properties of the securities. In this context, DMOs mentioned that one CRA published a preliminary assessment report stating that senior SBBS, as defined by that CRA, would not obtain a credit rating of AAA (Kraemer, 2017). However, the assumptions made by that CRA regarding the design of SBBS are not consistent with this report, as explained in Volume I. Ultimately, the opinions of CRAs and other relevant actors would depend on the final design of SBBS and the methodologies used to assess that design from the perspective of quantitative risk measurement. Section 1 of this volume describes possible quantitative methodologies in more detail.

Enabling regulatory framework for SBBS

DMOs expressed concerns about the appropriate design of an enabling framework for SBBS. In particular, DMOs would be concerned about a regulatory regime which penalises investors for holding government bonds, since such a regime would in their view destabilise sovereign bond markets. In this context, DMOs emphasised that the SBBS-specific enabling regulatory framework should not create undue preferential treatment for SBBS over sovereign bonds. These considerations are consistent with the model of the SBBS-specific enabling regulation elaborated in Section 5 of this volume.

4 Market design and liquidity

The goal of SBBS is to create low-risk assets through contractual seniority and euro area-wide diversification without requiring the mutualisation of sovereign risks. SBBS do not provide for any joint liability among Member States; therefore mutualisation of sovereign risks or potential losses is therefore excluded by design. All risks and potential losses must be borne by SBBS investors – first by investors in junior securities, then mezzanine, and subsequently – only if those securities are entirely wiped out – by holders of senior SBBS. Neither Member States nor European institutions would provide guarantees or paid-in capital to SBBS issuers or for SBBS payment flows. This exclusion of sovereign risk mutualisation should be reflected in SBBS contracts and the regulatory framework.

SBBS would be issued by bankruptcy-remote independent entities. The sole purpose of these entities would be to pass cash flows accruing on the asset side of their balance sheets (namely the interest and principal repayments at maturity from the diversified portfolio of sovereign bonds, net of administrative costs) to the liability side (complying with seniority in the event of missed payments) in a predetermined, algorithmic manner. All components on the liability side – the senior, mezzanine and junior securities – would be marketable debt securities. As such, the entity would have no internal equity or external credit support, it would not bear any market or credit risk, and it would, by construction, not be systemically relevant.

This section describes the design of an SBBS market in view of these core features of security design. Setting up an SBBS market requires careful design and consideration of potential side-effects for other markets. The section describes models for the issuance of SBBS (Section 4.1), the market's microstructure (Section 4.2), market development (Section 4.3) and the impact on sovereign bond market liquidity (Section 4.4). Due attention is paid to the conditions that would be necessary to foster a well-functioning SBBS market without impairing sovereign bond markets.

4.1 Issuance of SBBS

This section outlines the features of an SBBS issuance programme. It considers how to develop a demand-led process for issuing SBBS that provides the conditions for a liquid market to emerge with minimal disruption to national sovereign debt markets. Section 4.1.1 describes the general framework of SBBS issuance, and Section 4.1.2 sets guidelines for the SBBS-arranging and -issuing entities that would help to achieve these goals with economically viable issuance models.

There are two key aspects to SBBS issuance: (i) the venue of sovereign bond purchases by arranger(s) and (ii) the characteristics of the arranging and issuing entities. Sections 4.1.3 and 4.1.4 explore these two aspects in detail. In principle, purchases can be made on the secondary and/or primary markets by private and/or public arranging entities. Different considerations apply to each case. Secondary markets have the benefit of operational simplicity. However, this route could lead to heterogeneity in the cover pool and may expose the arranging entity to warehousing risk, depending on its use of an order book to collect binding commitments from investors. These issues could be resolved with primary market purchases, but this implies a

reform to existing market microstructures that would require close cooperation between the DMOs of participating Member States.

Robust institutional arrangements would be required to support SBBS issuance. In particular, the institutional arrangements underpinning SBBS issuance should provide for the exclusion of sovereign risk mutualisation, given that SBBS are intended to represent a demand-led initiative. The introduction of SBBS also requires a new regulatory framework and ongoing supervision. At present, regulation impedes the issuance of SBBS, since holders of the securities would be subject to additional requirements relative to direct holdings of sovereign bonds. To ensure the feasibility of SBBS, it would be necessary to change their regulatory treatment. Competent authorities would also need to provide a detailed specification of SBBS, the requirements for institutions involved (notably the governance of arranger(s) and issuers), the processes surrounding the issuance of SBBS, and rules regarding purchases of underlying sovereign bonds. These standards would need to be supervised on an ongoing basis. Supervision should ensure that homogeneity in SBBS standards is maintained, the regulatory treatment of SBBS is enforced, and operational risks (including potential market manipulation) are managed.

4.1.1 Steps in SBBS issuance

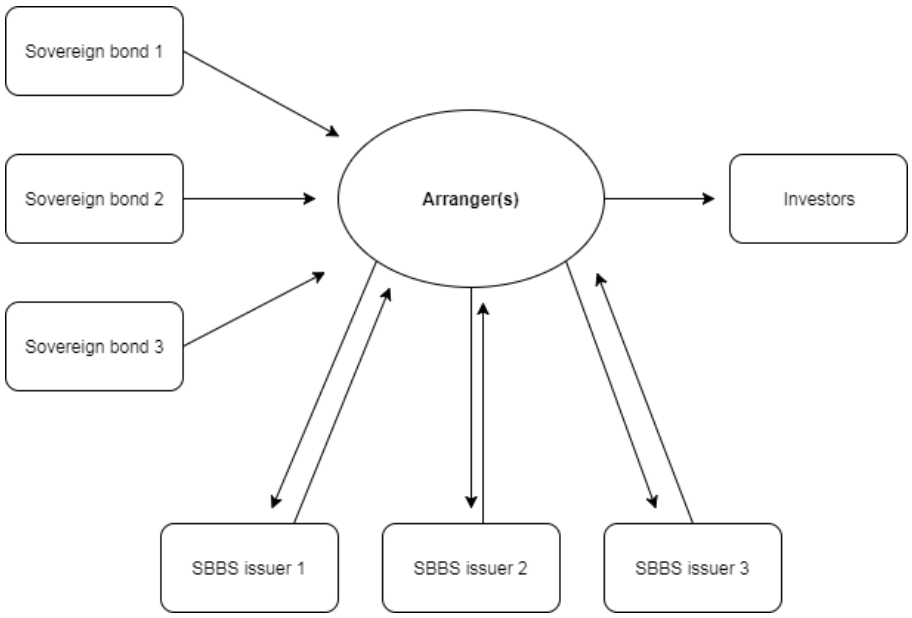
SBBS issuance would be an entirely demand-led process. The nominal size of the SBBS market would be determined by investor demand, with speed limits set by policy. Moreover, the size of the SBBS market would reflect the level of demand for the least demanded security.

SBBS-issuing entities would function as algorithmic and robotic firms that would not bear any market or credit risk. Their sole purpose would be to pass cash flows accruing on the asset side of their balance sheets (namely the interest and principal repayments at maturity from the diversified portfolio of sovereign bonds, net of administrative costs) to the liability side (complying with seniority in the event of missed payments) in a predetermined, algorithmic manner – akin to a "robot". All components on the liability side – the senior, mezzanine and junior SBBS – would be marketable debt securities. If a government were to default on its coupon or principal obligations, the missed payments would be borne by the most junior holders of SBBS. As such, the entities would have no internal equity or external credit support and would not bear any market or credit risk. Thus, by construction, they would not be systemically relevant.

SBBS arranger(s) would be bankruptcy remote from SBBS issuers. SBBS issuers would be independently established orphan shell companies with no previous trading or indebtedness, as described in Section 2.1. SBBS arranger(s) could therefore be either private or public in nature, as discussed in Section 4.1.4. The arranging entity or entities would be responsible for setting up the SBBS issuer. In addition, SBBS arranger(s) would be tasked with gauging investor demand for the securities, placing them with investors, and sourcing the underlying portfolio of sovereign bonds.

The issuance process would entail the following main steps for SBBS arranger(s):
(1) establishing investor interest in senior, mezzanine and junior SBBS in an order book;
(2) assembling the underlying portfolio of sovereign bonds insofar as there is demand for the three securities; (3) creating the SBBS-issuing entity, which in turn creates the securities backed by the underlying portfolio of sovereign bonds; and (4) selling the newly created securities to investors. This issuance process is illustrated in Figure 4.1.

Figure 4.1
Generic SBBS issuance model



Source: ESRB.
Note: The figure illustrates a generic issuance model for SBBS. Arranger(s) source sovereign bonds, transfer them to a newly created issuer that is responsible for manufacturing SBBS, and then satisfy orders for SBBS from investors.

Step 1: Opening and filling the order book for SBBS

Before assembling the cover pool, SBBS arranger(s) would collect interest from investors to gauge the size of the cover pool to be formed. To support this process, a roadshow would be needed, particularly for the first transactions, to present the novel structure to prospective investors (similar to roadshows that were carried out for ESM bonds when they were first introduced to markets). If this roadshow were to generate positive feedback, SBBS arranger(s) could announce details of the transaction at market opening and start collecting investor interest based on their initial "pricing thoughts". Once sufficient indications are collected, SBBS arranger(s) would then open the order book and start accepting orders based on the pricing guidance. Once the book is full and arranger(s) have elicited investor demand schedules, the final prices would be fixed.

The use of an order book would ensure that SBBS issuance is purely demand-driven, thus minimising warehousing risk for arranger(s). Orders for senior, mezzanine and junior securities would be placed in parallel. If demand for any one of the securities failed to match that for the other securities, issuance of the latter would be proportionally reduced. For example, if SBBS arranger(s) were to receive €70 million of orders for senior securities, €19 million for mezzanine securities and €8 million for junior securities, the €8 million order for junior securities would be the binding constraint on the overall size of the deal. SBBS arranger(s) would then assemble an underlying portfolio of €80 million for the purposes of issuing €56 million of senior, €16 million of mezzanine and €8 million of junior SBBS. A similar mechanism is already in place in the MBS market, where

"to-be-announced" forward contracts are used by MBS arrangers to lay-off inventory risks in their partially filled order books prior to selling the announced MBS (Gao et al, 2017). The existence of such a market allows prices and volumes to adjust so that the market clears in equilibrium.

Step 2: Assembling the cover pool

SBBS arranger(s) would then proceed to assemble the cover pool of sovereign bonds. To do so, SBBS arranger(s) would tap the primary or secondary market (or both) to source the cover pool as efficiently as possible. Section 4.1.3 contains further analysis of the considerations related to the different possible venues for purchases. Two-thirds of respondents to the industry survey answered "yes" or "probably yes" to the question of whether they would expect SBBS arranger(s) to be able to assemble the full portfolio within a week, given current characteristics of primary and secondary sovereign bond markets, with the remaining one-third of respondents answering "probably not". Still, arranger(s) should aim to keep the assembly time to a minimum, particularly during periods of financial stress, to avoid being unnecessarily exposed to market risks.

Step 3: Creating the SBBS-issuing entity

This next step would require SBBS arranger(s) to create the bankruptcy-remote issuing entity. To do so, the arranger(s) would appoint various third parties (including a trustee, accountant and lawyer for setting the representations and warranties) and establish the legal documentation. The arranger(s) would draft a programme prospectus that would define the portfolio weights and seniority structure. The arranger(s) would also solicit programme ratings from CRAs. Once this process is completed, SBBS arranger(s) would transfer the portfolio of sovereign bonds to the new issuing entity in exchange for a replicating portfolio of SBBS.

Step 4: Selling and servicing the SBBS

SBBS arranger(s) would close the order book once the senior, mezzanine and junior securities have been received from the issuing entity. At that point, the securities would be priced and the size of the deals determined. SBBS arranger(s) would proceed to sell securities to investors to satisfy their outstanding orders.

Subsequently, SBBS issuers or a third-party delegate would be responsible for administering the programme throughout the life of the SBBS contract. To do so, issuers would transfer coupon and principal payments to SBBS holders in accordance with their relative seniority. Depending on the degree of heterogeneity in these payments, issuers may need to perform a cash management function by setting up a bank account with an external (unrelated and highly rated) custodian bank. This account would be used to store early coupon or principal payments from a subset of sovereign bonds in the cover pool until they are due to be transferred to SBBS holders. In addition, SBBS issuers or their third-party delegates would maintain contact with CRAs and lawyers (regarding rating confirmations and prospectus revisions if required). SBBS issuers would therefore be operationally independent from arranger(s).

4.1.2 Economics of issuance

This section estimates the costs associated with SBBS issuance with the aim of shedding light on the overall economics of the deal. This analysis assumes a 70-20-10 seniority structure and provides indicative estimates of upfront and running costs based on related costs in ordinary securitisation transactions.

With an SBBS issuance programme of €6 billion, first-year issuance costs are estimated at approximately €4.41 million, with costs dropping to €3.26 million in subsequent years. Table 4.1 quantifies the breakdown of these cost estimates. Initial costs include hiring CRAs to establish the programme's credit ratings and retaining a legal adviser and other external advisers on structuring. Setting up the company that will issue SBBS incurs only a small cost. Issuance costs also depend on the volume of SBBS issued, as the lion's share of total costs is for pool servicing, which is proportional to programme size. Pool servicing could be outsourced to a third party or conducted by the issuer internally; the costs are estimated to be similar in both cases. In addition, there would be other ongoing costs for legal and accounting support and for confirmation of the programme's credit ratings by CRAs.

Table 4.1
Issuance costs associated with a hypothetical €6 billion SBBS programme

Panel A: Upfront costs

Category	Details	Estimate	Comments
Credit ratings	Ratings solicited from three CRAs	€600,000	€200,000 per CRA
Legal	Legal adviser to the issuer	€250,000	
Adviser(s)	Bank structuring team/external adviser	€250,000	
Issuer set-up	Administrative cost of setting up the company	€50,000	
Pool servicing agreement	No upfront costs		
Total		**€1,150,000**	

Panel B: Recurring costs per year

Category	Details	Estimate	Comments
Issuer costs	Accountants, tax advisers	€150,000	
Pool servicing	Sub-servicer fee (or employees and infrastructure costs in the event of internal management)	€3,000,000	0.05% of programme size
Credit rating	Rating confirmation upon issuance; rating maintenance and review (assuming ratings are solicited from three CRAs)	€60,000	€20,000 per CRA
Legal	Legal costs for new term sheets for each new issuance; costs of updating prospectuses	€50,000	
Total		**€3,260,000**	

Source: ESRB calculations.
Note: The table quantifies the likely operational costs associated with a hypothetical €6 billion SBBS programme, including both upfront costs (Panel A) and recurring annual costs (Panel B). According to this analysis, upfront costs associated with setting up the structure would amount to €1.15 million, while recurring annual costs would total €3.26 million. These operational costs would increase as a function of SBBS programme size.

These estimated issuance costs can be used to quantify the impact on the SBBS yields that could be paid to investors. For this analysis, assume that the underlying portfolio has an average maturity of 6.40 years and a yield-to-maturity of 0.23% (based on market prices as at 31 October 2016).[39] As shown in Table 4.2, SBBS are assumed to be issued at three maturities – two, five and 10 years – in proportions that closely match the pool's average maturity. The recurring costs from Table 4.1 amount to 0.054% of the volume issued. This must be deducted from cash flows accruing to sovereign bonds held by the issuer if it is to break even. This implies that the weighted average yield-to-maturity of all SBBS maturities and tranches must be 0.054% lower than that of the pool.

Depending on the issuance model, costs for managing heterogeneous cover pools might also need to be subtracted from SBBS yields. Despite near-matching of the average maturity of liabilities with that of assets, discrepancies in terms of specific assets could entail small asset-liability management risks that would need to be hedged by the issuer at a cost, potentially reducing SBBS yields. These costs could be avoided altogether with better asset-liability matching, which could be achieved by means of SBBS-specific issuances by DMOs (see Section 4.1.3).

Table 4.2
Portfolio assembly and SBBS issuance

(as at 31 October 2016)

	Portfolio assembly
Settlement amount	€6,000,000,000
Weighted average purchase price	111.97%
Weighted average yield-to-maturity	0.23%
Weighted average maturity	6.4 years
Recurring costs	€3,260,000
	Issuance
Size	€1,450,000,000 (2 years), €2,000,000,000 (5 years), €2,550,000,000 (10 years)
Maturity of issuance	Two, five and 10 years
Weighted average maturity	6.4 years

Source: ESRB calculations.
Note: The table reports the characteristics of a hypothetical €6 billion SBBS programme comprised of two-, five- and 10-year SBBS. Portfolio assembly is assumed to take place on 31 October 2016, when the weighted average yield-to-maturity of the pool was 0.23%.

On the basis of this hypothetical issuance programme, Table 4.3 shows estimated SBBS yields based on the results in Section 1.4, net of recurring administrative costs. These costs are assumed to be distributed proportionally across the securities and maturities. This implies that the senior security bears the largest part of the costs (owing to its greater thickness). Alternative ways of distributing costs (for instance, making the junior security bear a larger part of costs) could be conceived to better align offered yields with demand.

[39] The average maturity is calculated based on a pool comprised of eligible euro area central government bonds, where the weight of each bond is as reported in Table 2.1 in Volume I.

Table 4.3

Size and yield-to-maturity of a hypothetical SBBS issuance programme

(as at 31 October 2016)

	Two-year	Five-year	10-year
Senior SBBS			
Size	€1,015,000,000	€1,400,000,000	€1,785,000,000
Yield-to-maturity	-0.68%	-0.48%	0.08%
Mezzanine SBBS			
Size	€290,000,000	€400,000,000	€510,000,000
Yield-to-maturity	-0.25%	0.17%	1.29%
Junior SBBS			
Size	€145,000,000	€200,000,000	€255,000,000
Yield-to-maturity	0.66%	1.57%	4.83%

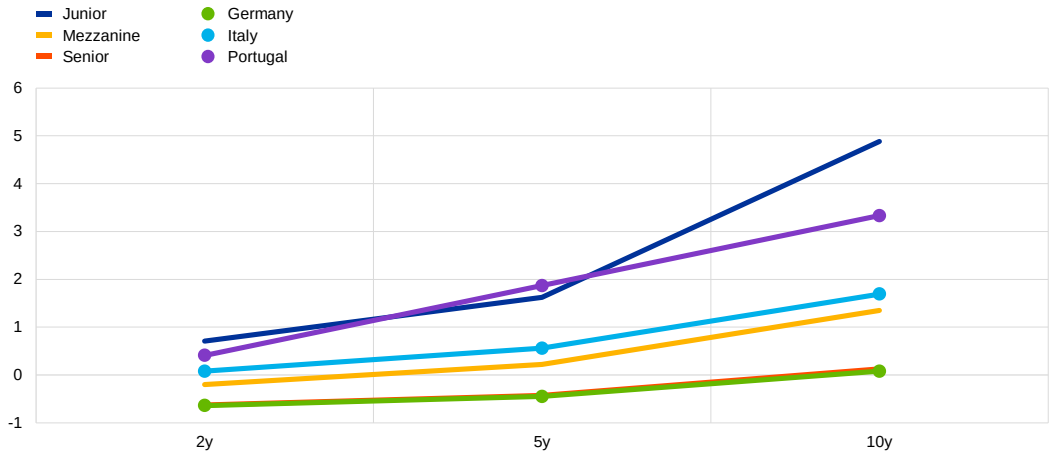
Source: ESRB calculations.
Note: The table reports hypothetical issuance sizes of and estimated yields on two-, five- and 10-year senior, mezzanine and junior SBBS (as at 31 October 2016). Yields on SBBS are calculated using the Monte Carlo simulations described in Section 1.4 net of the programme costs quantified in Table 4.1.

Figure 4.2 shows these estimated yields on senior, mezzanine and junior SBBS relative to those of benchmark German, Italian and Portuguese sovereign bonds. According to these calculations, yields on senior SBBS are close to those of German bonds. Mezzanine SBBS show a higher return, but one that is below Italian bonds. Junior SBBS offer a yield comparable to that of Portuguese bonds for the two- and five-year maturities, but more at the 10-year maturity point.

Figure 4.2

Estimated yields on 10-year SBBS compared with German, Italian and Portuguese bonds

(in percent)



Source: ESRB calculations.
Note: The figure plots the estimated yields on 10-year senior, mezzanine and junior SBBS compared with those on German, Italian and Portuguese sovereign bonds (as at 31 October 2016). Yields on SBBS are taken from Table 4.3, and are calculated using the Monte Carlo simulations described in Section 1.4 net of the programme costs quantified in Table 4.1.

4.1.3 Venue of sovereign bond purchases

To assemble the underlying cover pool, SBBS arranger(s) could operate in primary or secondary sovereign debt markets (or both). The venue of purchases has implications for the degree of neutrality of SBBS issuance with respect to the existing microstructure of sovereign bond markets, and for the extent to which arranger(s) bear some temporary and limited warehousing risk.

In principle, primary market purchases could be made in one of three ways (or some combination thereof):

(1a): SBBS arranger(s) compete alongside other investors in existing primary market issuances (i.e. ordinary auctions and syndications).

(1b): Participating DMOs allocate bonds to SBBS arranger(s) in a coordinated manner by tapping existing ISINs. This practice would be similar to existing re-openings reserved for primary dealers.

(1c): Participating DMOs allocate bonds to SBBS arranger(s) in a coordinated manner by creating new SBBS-specific ISINs. This practice would be similar to existing private placements, with the innovation that placements would be executed by DMOs simultaneously and with commonly agreed characteristics..

Option (1a) implies that SBBS arranger(s) would face heterogeneous market conditions, particularly in terms of issuance dates, due to the current non-uniformity in DMO issuance. Each DMO follows its own calendar of issuance (as shown in Table 4.4). This is because each Member State has its own individual timing needs in terms of funding. Heterogeneity in the timing of

issuances would therefore make it more difficult to issue SBBS immediately after the order book has been filled. Consequently, SBBS arranger(s) may be required to hold certain debt securities for a short period until the entire SBBS cover pool is assembled.

Option (1c) has the advantage that SBBS arranger(s) could more easily assemble a homogenous cover pool. If the SBBS-specific issuances created by DMOs were homogenous – notably in terms of issuance date and maturity – then SBBS arranger(s) could assemble a cover pool instantaneously, thereby avoiding warehousing risks, and one that has the same maturity date across sovereign bonds from different issuers, thereby avoiding ALM risks. This would avoid the need to use treasury operations to manage differing maturities. On the other hand, this option would require DMOs to coordinate the timing of their private placements, which has not been done to date, as explained in Section 3.4. For that reason, option (1a), and to a lesser extent option (1b), would represent a less significant departure from the current microstructure of sovereign bond markets.

Table 4.4

Monthly bond issuance by euro area central governments in 2016

(in € billions)

Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Austria	1.35	6.11	1.10	1.10	1.21	1.19	1.23	0.55	1.45	6.38	-	1.21
Belgium	5.00	2.82	3.50	9.50	-	4.08	3.43	-	4.55	1.81	2.30	-
Cyprus	0.30	-	-	-	-	-	1.00	-	-	-	-	-
Germany	11.00	16.00	17.00	9.00	14.00	14.00	15.00	18.00	14.00	8.00	14.00	3.00
Spain	18.71	6.81	12.81	6.19	8.26	11.21	15.84	3.06	8.46	7.80	6.88	4.67
Finland	1.50	-	4.00	-	-	1.00	-	3.00	-	1.00	1.00	-
France	19.52	19.75	17.61	22.98	17.47	17.33	21.18	6.00	16.64	13.86	15.35	4.38
Ireland	3.00	1.00	-	0.75	0.75	-	-	-	1.00	1.00	0.75	-
Italy	17.01	25.20	20.64	22.50	18.07	14.76	20.83	7.66	19.68	22.00	17.25	7.24
Lithuania	-	-	-	-	0.03	0.05	0.07	0.05	0.06	0.07	0.06	0.03
Latvia	-	0.01	-	0.03	0.67	0.03	-	0.03	0.69	0.03	0.03	-
Malta	-	-	0.06	-	-	0.22	0.21	-	-	0.16	-	-
Netherlands	1.36	-	5.72	1.01	2.86	4.81	2.39	-	4.32	1.87	2.28	-
Portugal	4.00	-	2.39	1.50	1.37	1.07	1.16	1.13	0.75	1.00	0.70	-
Slovakia	1.00	-	-	0.19	0.65	0.24	-	-	0.15	0.30	0.51	-
Slovenia	-	1.50	-	-	0.50	-	-	-	-	1.00	-	-
Total	**83.74**	**79.20**	**84.82**	**74.75**	**65.83**	**70.00**	**82.33**	**39.48**	**71.73**	**66.27**	**61.12**	**20.53**

Sources: Bloomberg and Morgan Stanley.
Notes: The table shows sovereign bond issuance in the primary market in 2016 for each euro area Member State. This dataset focuses only on euro-denominated central government bonds issued in 2016, with a maturity of two or more years and a fixed coupon.

Besides operating in primary markets, SBBS arranger(s) could assemble cover pools of sovereign bonds in secondary markets. This would be straightforward insofar as it would not require any change in primary market issuance activity. Moreover, it would allow the SBBS market to develop significant depth relatively quickly, as the cover pool could be created out of the existing stock of debt securities rather than the flow of newly issued debt securities. There are two options for SBBS issuers looking to operate in secondary markets:

(2a) SBBS arranger(s) assemble the underlying cover pool in open secondary markets.

(2b) SBBS arranger(s) acquire the underlying cover pool from a specific investor or investors with a sufficiently large and diversified portfolio.

Both options (2a) and (2b) would require SBBS arranger(s) to purchase sovereign bonds with heterogeneous characteristics, although the extent of heterogeneity might be lower under option (2b). SBBS arranger(s) would therefore need to handle the resulting heterogeneity in the underlying cover pool (in the form of timing mismatches in maturity and coupon payments), which would require a cash management function (by which the proceeds from early maturing bonds are stored in a custodian bank account). However, this would not prevent SBBS issuers from being robotic entities without discretionary powers, as cash management is a straightforward exercise and, like other administrative activities, could be delegated to third parties that execute tasks defined by contract.

In the survey, just under a quarter of respondents said that using existing portfolios would be the most practicable way to assemble the underlying portfolio. However, most prospective SBBS arranger(s) would not have an existing portfolio matching the weights defined in Volume I. They would therefore need to source suitable portfolios held by other institutions and obtain those portfolios at market prices. Additionally, option (2b) may be preferable to (2a) insofar as large-scale purchases in open secondary markets might generate additional price volatility when those markets are thin, although the Eurosystem's implementation of its PSPP has demonstrated that it is possible to carefully calibrate large-scale secondary market purchases in a manner that limits market disruption (see Section 4.4.1). This problem would anyway not arise in the case of an over-the-counter transfer of a diversified portfolio of sovereign bonds from one large balance sheet to those of SBBS arranger(s).

Comparing all of the options, it is clear that options (1b) and (1c) pose fewest difficulties in terms of heterogeneity in the SBBS cover pool. Most survey respondents stated that it would be most practicable to assemble the underlying portfolio on primary markets, and all except one stated that coordinated DMO issuance on the primary market would significantly or partially alleviate warehousing risk. Implementing these options would require the microstructure of primary markets to be reformed to reduce the extent to which SBBS arranger(s) would need to warehouse debt securities. Such reform would only need to take place for the fraction of debt securities earmarked for packaging into SBBS; hence, the existing microstructure could be maintained for the debt securities intended for placement in open markets. As elaborated in Box 4.A, microstructure reform implies one of the following:

- **Under option (1b), DMOs coordinate to simultaneously tap existing ISINs.** The ISINs to be tapped would be selected to maximise cross-country similarity in residual maturity and other aspects of the bond payoff structure. The tapped ISINs would be allocated to SBBS

arranger(s) at a price that corresponds to the market price of the same ISINs in secondary markets.[40] As the tap would be simultaneous across sovereign bond issuers, SBBS arranger(s) would not need to warehouse national sovereign debt securities, since the cover pool would be created in one shot. Arranger(s) could assemble orders for SBBS from investors in advance to facilitate the placement of the three securities in open markets. To eliminate warehousing risk in the three securities, SBBS arranger(s) could sell the senior security only insofar as it has received buy orders for the subordinated securities, as explained in Section 4.1.1. This would avoid SBBS arranger(s) being left with unsold junior securities. In addition, if SBBS arranger(s) are left with unsold SBBS, these could in principle be converted back into the diversified portfolio of national sovereign bonds.[41]

- **Under option (1c), DMOs coordinate to create SBBS-specific ISINs with identical maturity dates.** These ISINs would be unique to the SBBS cover pool and would therefore not be traded in secondary markets. As such, they would not have the same levels of liquidity. The SBBS-specific ISINs would be privately placed with SBBS arranger(s) at a price corresponding to the market price of comparable ISINs in secondary markets. As the placement of SBBS-specific ISINs is simultaneous, SBBS arranger(s) would not need to warehouse national sovereign debt securities. Moreover, owing to the homogeneity of the cover pool in terms of both issuance and maturity dates, SBBS arranger(s) would not need to manage heterogeneous cash flows, thereby simplifying their operations relative to option (1b).

Allocation from DMOs to SBBS arranger(s) would take place at a price that corresponds to the nearest benchmark market rate in secondary markets.[42] This market price would be readily observed by all market participants and would be difficult to manipulate owing to the depth of liquidity in secondary markets. In addition, the allocated tap or private placement could take place at some small fixed premium relative to the market price, as is typical in private placements. This could allow DMOs to reduce their average financing costs.

Option (1b) has the merit that the ISINs in SBBS cover pools would be perfect substitutes for ISINs held directly by other investors. This perfect substitutability would increase the value of a securities lending facility, whereby SBBS issuers temporarily lend out specific bonds to market participants (secured against cash or other high quality collateral). The purpose of such a facility would be to mitigate the adverse "freezing effect" of SBBS, which arises due to the fact that national sovereign debt securities would be kept on the balance sheets of SBBS issuers, making them unavailable for market operations. Such a facility has been implemented for similar reasons in the context of the Eurosystem's PSPP. The implementation of such a facility in the case of SBBS would need to be made compatible with the purely pass-through nature of the issuing entities.

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[40] Alternatively, in the case of multiple private SBBS issuers, price formation could take place via a syndication or auction mechanism.

[41] This conversion requires SBBS issuers to hold a replicating portfolio of the three securities. Indeed, SBBS arranger(s) would in fact hold such a replicating portfolio, thanks to the restriction that they only sell senior SBBS in proportion to the buy orders that they receive for the subordinated tranches.

[42] In the case of multiple private SBBS arrangers, an alternative would be for those issuers to engage in competitive pricing via a syndication or auction mechanism. However, lower liquidity in primary markets may give SBBS arranger(s) an incentive to strategically bid-up the yields on national sovereign debt securities, so as to increase the weighted average yield on the cover pool, and thereby the expected return for the end investors in SBBS. Such strategic bidding would be more difficult to execute if the primary market price were set as a function of the market price in secondary markets.

By contrast, an SBBS securities lending facility would be of lesser value under option (1c), since SBBS-specific ISINs would be only imperfect substitutes for other ISINs held directly by other investors. On the other hand, SBBS-specific ISINs would enhance operational simplicity for SBBS issuers, as the cover pool would be perfectly homogenous in terms of maturity dates and other aspects of the bond payoff structure. These various considerations should be taken into account when deciding on which SBBS issuance model to adopt.

Box 4.A

Options for coordinated primary market issuance

This box describes two options for coordinated primary market issuance by DMOs. The objective of such coordinated issuance would be to create euro area sovereign bonds with characteristics that are amenable to securitisation by SBBS arranger(s) and issuers.

Allocated taps (option 1b)

After standard auctions, DMOs sometimes reserve a fraction of a bond to be placed with a primary dealer at the average of the price quoted in the auction. These so-called “reserved re-openings” sometimes take place a day or even several days after the initial auction. A possible adaptation of this method to the case of SBBS is explained in the following steps:

- DMOs conduct their planned auctions in which they issue new bonds following their usual procedure.
- In parallel, SBBS arranger(s) contact investors to gauge demand for SBBS from investors, compiling expressions of interest in a limit order book.
- DMOs then tap the ISINs that they issued in the auction and place them with SBBS arranger(s). The price of the national sovereign debt securities placed with SBBS arranger(s) could be set at the auction price (if the tap occurs shortly after the auction) or as a function of the secondary market price (if the tap occurs some time after the initial auction).
- SBBS arranger(s) transfer the completed cover pool to a newly created SBBS issuer, which creates the SBBS replicating portfolio to be transferred back to the arranger. SBBS arranger(s) then sell SBBS to investors to satisfy their open orders. Senior SBBS are placed with investors only insofar as there are buy orders for the subordinated securities, thereby avoiding the risk that SBBS arranger(s) are left holding the subordinated securities at the end of the day.

One open question in this issuance model is how to deal with placement risk, namely the risk that investors renege on orders placed with SBBS arranger(s). One solution would be for DMOs to offer arranger(s) the possibility to buy back bonds that fail to be placed with investors. DMOs would never end the day worse than they started it, and SBBS arranger(s) would know in advance that they would never bear any placement risk.

DMOs may nevertheless be concerned that a placement failure would lead to reputational damage. In general, DMOs are concerned about failed auctions because of the damage it can instantly do to the price of a bond in the secondary market. In the case of SBBS, a partial buy-back of a private placement would probably not strongly affect secondary prices, and could be seen as less

problematic for that reason. In fact, it could even be perceived as a sign of the attractiveness of the residual national government bonds relative to SBBS, on which DMOs may place greater weight.

In the absence of such a buy-back mechanism, one could examine certain processes that could help significantly reduce placement risk such that none of the agents is displaced by bearing it. Below is a list of possible designs:

- SBBS arranger(s) obtain from DMOs only enough bonds to satisfy a conservative estimate of overall SBBS demand. This conservative bias is likely to lead to a systematic over-subscription in SBBS: in this case, the SBBS issue can be reopened to satisfy the excess demand.
- SBBS arranger(s) contact the DMOs with a size range to hedge the risk that some investors do not follow through on their orders. The issuance size is finalised near the end of the day once all investors have placed orders. In fact, it is not uncommon in primary markets for issuers to leave issuance sizes open. In this way, DMOs and SBBS arranger(s) could be in regular communication throughout a trading day about the evolution in likely investor demand for SBBS.
- SBBS arranger(s) require investors to place binding orders for SBBS, possibly following the model of "to-be-announced" forward contracts that are used by MBS arrangers to lay-off inventory risks prior to selling MBS (Gao et al, 2017).

SBBS-specific ISINs (option 1c)

This issuance model entails a private placement of bonds that are specifically structured to meet the needs of SBBS arranger(s). DMOs each create an SBBS-specific ISIN that would be the same in terms of maturity across countries and would be privately placed with SBBS arranger(s) on specific days of the year.

The main benefit of this approach is that it achieves perfect homogeneity of the cover pool. A cash management function would therefore not be required. This would help to decrease the cost of issuance. In addition, it would create a perfectly homogeneous product with a simple and fixed payment structure.

On the other hand, the issuance of SBBS-specific ISINs would require DMOs to change their planned issuance strategies at the margin. Since the SBBS-specific ISINs would have perfect cross-country matching in terms of the timing of payments, this would affect DMOs' weighted average duration of liabilities. In equilibrium, DMOs could offset this effect by adjusting the duration of bonds not intended for SBBS.

This issuance model may entail liquidity implications. A specific ISIN created only to be placed with SBBS arranger(s) would not be traded in the market. Hence, the price discovery mechanism would be less efficient for this specific ISIN, as it is for any private placement currently conducted in sovereign debt markets. The underlying bonds would be "frozen" in the SBBS issuer's balance sheet, and investors would have as a reference price only traded securities that are close substitutes but not identical to the ones included in the cover pool. The assets of SBBS arranger(s) would therefore be less useful in a securities lending facility under this issuance model.

4.1.4 Considerations on public or private arrangement

This section assesses the conditions necessary to ensure successful public or private SBBS arrangement without mutualisation of sovereign risks. In both cases, the issuance model previously described in this section would help to ensure that an SBBS arranger is not left with any residual claim on the underlying portfolio, therefore avoiding mutualisation of sovereign risks and losses. In particular, an order book for all three securities would be filled before assembling the underlying portfolio. SBBS arranger(s) would then purchase government bonds only insofar as there is sufficient demand for all three securities. This ensures that the issuance of SBBS is purely demand-driven, thus eliminating any risk of retaining SBBS and minimising warehousing risk. From an operational point of view, funding of the underlying portfolios would be limited in time, if required at all.

Despite these commonalities, specific considerations apply to public or private arrangement. Public sector arrangement implies that there would be a single, monopolistic supplier of cover pools intended for securitisation into SBBS. By contrast, private sector arrangement would most likely be conducted by multiple institutions that would be in competition with one another. This implies that a greater degree of regulatory and supervisory scrutiny would be required in the case of private sector arrangement to ensure that different arrangers adhere to common SBBS design principles.

Public sector arrangement

Arrangement by a public entity should be designed to avoid mutualisation of sovereign risks. This is a basic tenet of SBBS, distinguishing them from other instruments that entail mutualisation (see Volume I). In particular, arrangement by a public entity should occur in a way that does not force it to retain mezzanine or junior SBBS. In this context, the use of an order book is an important device to ensure that an SBBS arranger is not left with any residual claim on the underlying portfolio. In addition, key elements to reduce the expectation of implicit guarantees include transparency about the legal aspects concerning losses accruing to SBBS holders. Moreover, public sector arrangement of SBBS should be conducted in a way that does not change market perceptions regarding the use of existing crisis management tools.

Public sector arrangement would require administrative responsibilities to be conferred on a public entity. This report does not take a view on which type of public entity would be best placed to perform such services. In principle, it could be done by a new public entity, thus requiring new legislation to create that entity, or an existing entity. Box 4.B presents legal considerations on the possible involvement of the ESM in the arrangement of SBBS. In addition, a public entity could use private sector services for administrative tasks associated with issuance. For example, advice from existing private sector institutions already involved in securitisation might prove useful when drafting the prospectus and executing the issuance (as outlined in Section 4.1.3).

Box 4.B

A legal analysis of the possibility for ESM involvement in SBBS

The European Stability Mechanism (ESM) can only act within the confines of competencies ascribed to it by the ESM Treaty. The ESM Treaty does not ascribe an explicit competence to issue SBBS, which would involve establishing and managing an independent issuing entity. However, this does not necessarily preclude the ESM from involvement. This box examines three options by which the ESM could be involved in the issuance of SBBS: (i) through the adoption of a new financial assistance instrument (by virtue of its implied powers); (ii) a more limited involvement (e.g. as an arranger); and (iii) through a potential amendment to the ESM Treaty.

The ESM Treaty (Article 19) gives the ESM Board of Governors competence to approve new financial assistance instruments that provide stability support. The use of the instrument must be "indispensable to safeguard the financial stability of the euro area", the support must be made "subject to strict conditionality", and the basic rules for decision-making must be complied with (Article 13). None of these elements would apply to the issuance of SBBS by the ESM.

The ESM could have recourse to its implied powers. For this, the ESM would need to demonstrate that assuming a new task would be "necessary" for the performance of its duties. According to Article 3, the "purpose of the ESM shall be to mobilise funding and provide stability support under strict conditionality, appropriate to the financial assistance instrument chosen, to the benefit of ESM members which are experiencing, or are threatened by, severe financing problems, if indispensable to safeguard the financial stability of the euro area as a whole and of its Member States. For this purpose, the ESM shall be entitled to raise funds by issuing financial instruments or by entering into financial or other agreements or arrangements with ESM members, financial institutions or other third parties". Even though SBBS are related to euro area financial stability, this does not suffice to argue that the issuance of SBBS would be "necessary" for the ESM to fulfil its duties.

A more limited role of the ESM might be considered under Article 38, which states that the "ESM shall be entitled, for the furtherance of its purposes, to cooperate, within the terms of this Treaty, with the IMF, any State which provides financial assistance to an ESM Member on an ad hoc basis and any international organisation or entity having specialised responsibilities in related fields". One would consider SBBS arranger(s) and issuers as the "entity" referred to in Article 38. The ESM could then provide (technical) assistance to such an entity. Given the purpose of SBBS, it could be argued that the ESM's role would be "for the furtherance of its purposes".[43] Given that Article 38 is rather vague, however, the ESM Board of Governors would need to adopt a resolution by qualified majority, based on Article 5(7)(n), to specify the ESM's engagement in that respect.

Finally, policymakers could consider amending the ESM Treaty to give the ESM a specific mandate in the issuance of SBBS. Clearly, this would require intergovernmental agreement on the parameters of such an amendment.

[43] This assessment still applies if government bonds of non-euro area Member States form part of the underlying portfolio, as this would still "further" the purposes of the ESM.

Private sector arrangement

The arrangement of SBBS by a private entity would only be effective if multiple private sector arrangers were operating in competition with each other. Multiple arrangers would deliver competitive market conditions for the creation of the cover pool for SBBS. As with public sector arrangement, an adequate design requires the use of an order book which ensures that cover pools are created only insofar as there is investor interest in SBBS.

In addition to an SBBS-specific product regulation, oversight would be necessary to ensure the integrity of SBBS. A supervisor would need to enforce standardisation requirements on different issues of SBBS and verify the consistency of the issuance steps. In addition, enforcement of rules should ensure that there is no possibility of market manipulation in SBBS issuance.

Private sector arrangers would need to operate without paid-in capital from Member States and without implicit or explicit public guarantees. The latter aspect is important to ensure compliance with a key tenet of SBBS, namely that they do not entail the mutualisation of sovereign risk.

4.1.5 Governance of arranger(s) and issuers

The governance of SBBS is inspired by principles of market discipline and no mutualisation of losses or risks among Member States. This could be achieved through prescriptive regulation. An SBBS-specific product regulation and accompanying technical standards and guidelines could set the rules for SBBS arrangement and issuance, including the conditions that must be fulfilled for an entity to be licensed as an SBBS arranger. The regulation should also ensure good governance and accountability of SBBS arranger(s). Governance arrangements should ensure that no mutualisation (either directly or indirectly) would occur and should, as far as possible, avoid any signalling or branding effect which could arise if markets misperceive the SBBS initiative as constituting implicit public support for SBBS payment flows.

In the case of private sector arrangement, the main objective of regulation and supervision would be to manage operational risk and ensure harmonisation across SBBS vintages. With regard to operational risk, enforcement of rules should ensure that there is no possibility of market manipulation in SBBS issuance, in both normal and stressed periods. Rules could be enforced by means of a licence to issue SBBS.

An SBBS-specific product regulation could also be used to better explain the structure to investors, thereby contributing to transparency. If SBBS arrangement were delegated to private sector arrangers, the regulation would be a further necessary, though not sufficient, condition for maintaining homogeneity of the issuance and good governance of the arrangers. To ensure compliance, however, there would also be a need for adequate supervision. A regulation together with its accompanying technical standards and guidelines should cover contractual aspects of SBBS around the following key areas:

1. **The dynamics of the definitions of SBBS over time.** In particular, the regulation could clarify the extent to which the underlying contractual elements can change over time. Based on responses from market participants, some key elements should remain relatively fixed in

order to provide certainty. In particular, market participants highlighted that a free choice of portfolio weights or the seniority structure would be disruptive as it would be difficult to understand the properties of each new product. The portfolio weights and seniority structure should therefore be precisely specified, and transparent rules should be established for them to be changed (to a limited extent) over time. This would help to maintain sufficient homogeneity in the risk properties of SBBS over time.

2. **Definition of the relationship between securities and the underlying pool of assets.** A regulation together with its accompanying technical standards and guidelines should define the issuance process, the waterfall of payments between securities, and the details of the order book approach. Furthermore, the regulation should reiterate that no guarantee, implicit or explicit, is provided for SBBS payment flows. This would help to counteract misperceptions from market participants.

3. **Definition of SBBS issuers and their rules of governance.** A regulation together with its accompanying technical standards and guidelines should define the legal nature and the mandate of the issuers. The mandate of the issuers should be to hold the underlying bonds to maturity and finance themselves by selling the securities. This mandate should prohibit them from holding proprietary security positions on their own account. A regulation together with its accompanying technical standards and guidelines could also specify the transactions permitted in the issuing process, including rules on what the issuers can do with their portfolio of sovereign bonds. Furthermore, the issuers should be ring-fenced to avoid any conflicts of interest.

4. **Clarity about the behaviour of SBBS issuers when debt restructuring might be necessary.** A regulation together with its accompanying technical standards and guidelines should include governance rules related to the debt restructuring procedure. This relates to how the issuer would vote in the restructuring process (distribution of voting rights), as discussed in Section 2.

5. **Enforcement.** A regulation could establish external supervision to ensure that the SBBS structure strictly follows its mandate (characteristics of the underlying portfolio and issuances, cash flow allocation, periodicity of investment and issuances, type of credit enhancement, allocation of cost and profitability of the structure, allocation of losses) in addition to any internal control or risk management process. This mandate should be clearly defined and detailed in advance.

4.2 Microstructure of the SBBS market

This section highlights the market microstructure aspects of SBBS that are relevant for market liquidity. In particular, it discusses standardising SBBS across vintages (Section 4.2.1); the use of SBBS in repurchase (repo) agreements and the development of futures markets referencing SBBS; the inclusion of SBBS in benchmark indexes that are tracked by passive investors; and the role of primary dealers in making markets in SBBS. All of these aspects can help to support SBBS market liquidity, which is particularly important in an early phase of market development.

4.2.1 Standardisation across SBBS vintages

Developing a liquid SBBS market requires a high level of product standardisation. This is a necessary for the smooth functioning of an SBBS market, characterised by transparency, high turnover and efficient price formation. The corollary of this insight is that poor standardisation of SBBS would lead to multiple fragmented market segments with their own idiosyncrasies. This would impair overall market liquidity and price formation, the effectiveness of which is critical for new SBBS issuances in particular.

Crucially, different SBBS vintages should have comparable cover pools and seniority structures. Deviation from target portfolio weights would only be permitted under certain circumstances, such as a violation of issuer limits, (changes in the ECB capital key or violation of the market access criterion. The seniority structure, meanwhile, would be fixed in advance in an adequately conservative manner to ensure that subsequent re-calibrations (e.g. to achieve rating targets) are unnecessary in most future states of the world. This quasi-fixed parameterisation of portfolio weights and the seniority structure would help to provide a substantial degree of standardisation, while stopping short of fully time-invariant standardisation to allow for ongoing flexibility in SBBS design as required.

In addition, the design of SBBS contracts should be standardised across vintages. In the case of multiple private SBBS issuers, this would require SBBS to be issued under the same contractual conditions and to be structured in the same way. Such standardisation could be ensured by regulation and ongoing supervision of SBBS arrangers. In addition, SBBS-issuing entities should be bankruptcy-remote, so that the creditworthiness of SBBS arranger(s) does not affect the perceived riskiness of SBBS from different issuers.

Standardisation could be further enhanced if SBBS issuers were to regularly tap previous issues. In current sovereign bond markets, DMOs often add to the outstanding amount of a bond in the months following an initial issue, enabling investors to bid for an ISIN which already exists and for which a secondary market reference price is readily available. This “tapping” process could also be applied in the SBBS market, where the SBBS-issuing entity would, for example, issue a 10-year SBBS series in January (backed by 10-year central government bonds purchased by private placement) and tap the same ISIN several times within a year (backed by corresponding taps of the same government bonds). In this way, regular taps could become an important feature of SBBS market microstructure in supporting liquidity, as investors typically prefer smooth issuance calendars, with pre-announced volumes and homogeneity across different series. This would help to create a liquid market, particularly in its early development stage.

Current practices in private securitisation markets indicate why standardisation is important in fostering market liquidity. Despite regulatory efforts to create a standardised European securitisation market, the market remains fragmented along national and product lines. This fragmentation impairs the development of a well-functioning pan-European market for securitised products. There is a risk that SBBS fall into the same trap, with heterogeneity across vintages in terms of the cover pool, seniority structure and other relevant characteristics. To mitigate this risk, experience from the private securitisation market could help to inform the development of a standardised SBBS market (see Box 4.C).

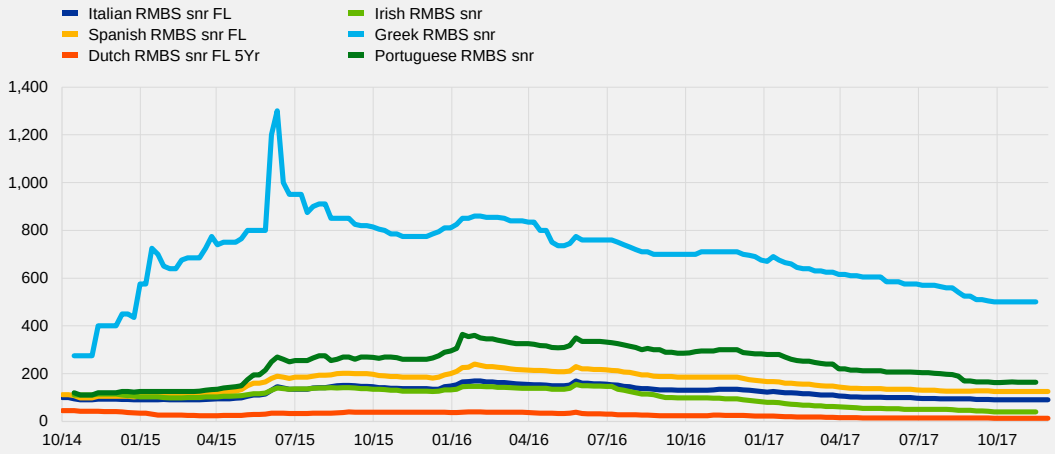
Box 4.C
Fragmentation in European securitisation markets

Current securitisation markets in Europe are fragmented. . Since investors are not always active in the various segments, there are different market dynamics within each segment. This hampers overall market liquidity. Various factors can explain this fragmentation, including different credit dynamics per asset class and country, different legal and regulatory frameworks, the relative strength of sponsors and originators, and perceived linkages with country-specific risks.

Figure A illustrates the different pricing dynamics for various segments of the European asset-backed securities (ABS) markets. Despite some convergence in recent years, significant cross-country pricing differences remain for securities with ostensibly comparable risk properties.

Figure A
Spreads on senior RMBS by country and over time

(in basis points)

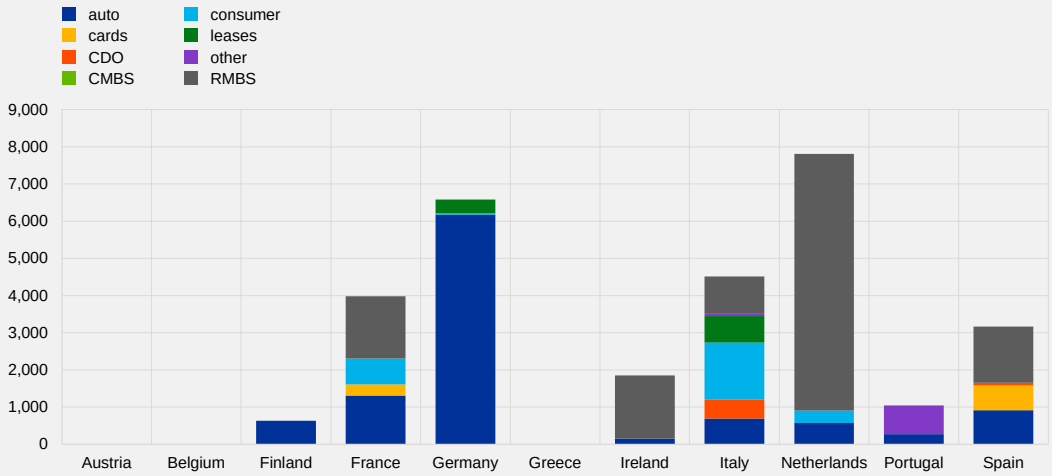


Source: JPMorgan.
Note: The figure shows spreads on the senior tranche of retail mortgage-backed securities (RMBS) originated in Italy, Spain, Portugal, Greece, Ireland and the Netherlands (owing to data availability). Spreads are given in basis points over national sovereign bond yields.

The fragmentation in existing securitisation markets can also be illustrated by market volumes in new issuances in the primary market and trading volumes in the secondary market. Figure B shows that issuance volumes are concentrated in a limited number of countries and asset classes, notably Dutch RMBS and German auto loans, affecting the level of liquidity compared to other segments.

Figure B
Distributed issuance by country and asset class

(in millions of euro)



Source: JPMorgan.
Note: The figure shows the volume of distributed issuance (in millions of euro) of asset-backed securities broken down by country of origination and the asset type underlying the securitisation.

A similar degree of fragmentation can be observed in secondary markets. Trading volumes are typically concentrated in a limited number of markets. Data extracted from research by Bank of America Merrill Lynch reveal the extent of differences in liquidity across market segments, with most of the trading activity concentrated in a small number of market segments.

Another illustration of the difference in liquidity across market segments is given by bid-offer spreads. Although it is difficult to find accurate data, market participants' feedback suggests that bid-offer spreads in Dutch RMBS are in the order of magnitude of single-digit basis points, whereas Spanish and Italian RMBS typically trade with double-digit bid-offer spreads.

4.2.2 Repurchase agreements and futures markets

The development of active futures and repo markets referencing and using SBBS would support market liquidity. A well-functioning repo market for these bonds is of primary importance, while the existence of a futures market based on these contracts would also assist with market liquidity.

A natural function of low-risk assets lies in their use as collateral in financing transactions such as repos. Repo markets are a key source of liquidity for market-makers and an important source of collateralised borrowing. In this regard, the availability of senior SBBS as collateral for secured transactions is linked to the policy objectives underpinning SBBS. To support the incremental development of an SBBS market, it would be important to ensure that senior SBBS are able to be accepted as collateral by a broad set of market participants. The following characteristics of senior SBBS would help to make the security suitable as collateral in repo transactions:

- stability in credit risk properties (see Section 1);
- high liquidity across the curve so that they may be easily sold and transacted (see Section 4.3);
- acceptance and risk-adequate treatment as collateral in refinancing operations at Eurosystem central banks (see Section 4 in Volume I).[44]

The ability to repo senior SBBS is important for banks in particular. Banks need to be able to mobilise assets in a timely and cost-efficient manner, either at the central bank in open market operations or in private markets. For other market participants, such as asset management firms and hedge funds, repos play an important role in supporting trading activities. For market-makers, the ability to source bonds in the repo market helps them to offer two-way prices to customers. If market-makers cannot source these bonds easily in the repo market, they are unlikely to provide liquidity to their clients for fear of failing to source the requested bonds post-trade.

A futures market referencing SBBS would also help to support market liquidity, although it is of lesser importance compared with their use in repo markets. The development of a futures market referencing SBBS is not a prerequisite for a liquid SBBS market. Most euro area government bond markets are not associated with an active futures market. However, the development of an active futures market for SBBS would contribute to the development of a highly liquid SBBS market, as they give investors a wider array of options for hedging and asset allocation.

Market participants use government bond futures for hedging, investing, arbitrage, market-making and speculation. Futures offer a leveraged and liquid exposure to government bonds, as holders of futures contracts do not actually own the underlying bonds unless they are held to expiry. For example, asset managers often hedge portfolios of sovereign bond holdings through futures contracts. In addition, hedge funds and other investors utilise sovereign bond futures as a proxy for

[44] Inclusion as eligible collateral for Eurosystem open market operations would have the important ancillary benefit of gaining automatic inclusion in Eurex's GC Pooling basket, which is a key source of repo liquidity for private markets.

cash holdings. In this way, liquidity in futures markets can have positive spillover effects for liquidity in cash markets.

Furthermore, futures markets can provide a cheaper alternative – in terms of transaction costs – to trading in cash markets for sovereign bonds. The centralised order flow of a futures exchange means that an investor is guaranteed to always receive the best available quote in the market, compared to asking multiple dealers for quotes. Searching for good quotes can be expensive, implying higher transaction costs. This is especially true for mid-sized financial institutions and public traders that do not have access to the low transaction costs and better quotes enjoyed by dealers. Often, non-professional market participants may never find a quote in the cash market that is as low as the bid-ask spread available in the futures market.

A key benefit of futures markets is that they help with price discovery. This is an information-based contribution rather than due to increased transaction volume. The existence of a price for future delivery of senior SBBS gives an additional reference point for investors, helping them to make decisions based on better information and quickly arbitrage away pricing inefficiencies.

A futures market could also help with the internationalisation of the SBBS investor base. Foreign investors may find SBBS more appealing in the presence of an active futures market, which would grant them more options for managing their exposure to euro area sovereign credit risk as well as interest rate risk. Also, the existence of a futures market would signal that the cash market functions well, making non-European investors more comfortable in investing in a new asset class.

The existence of a futures market depends on a cash market that is sufficiently standardised, liquid and large. Futures markets for government bonds are well established, but are only seen in markets with significant scale. The German, French, Italian and Spanish government bond markets have well-developed futures markets, but futures markets have not developed in countries such as Ireland, Portugal, Finland and the Netherlands, where the overall size of the market is smaller.

Developing a futures market referencing SBBS is likely to be a private sector initiative that would develop gradually in expectation of sufficient scale in the SBBS cash market. It would occur based on expectations that the SBBS market will grow steadily over time and provide regular supply to the key maturity buckets, particularly the two-, five- and 10-year benchmarks, which underscores the importance of developing these maturity points in an early phase of market development. Appropriate SBBS market design – particularly with respect to maturity selection and the regularity of issuance – could therefore help to facilitate the development of a futures market. Moreover, to provide further impetus to the futures market, SBBS arranger(s) could be incentivised to provide liquidity in SBBS futures as well as the cash market.

Market intelligence suggests that the infrastructure underpinning a well-functioning futures market for SBBS should develop naturally. Specifically, futures exchanges are likely to attempt to create the necessary infrastructure underpinning an SBBS futures market if senior SBBS are sufficiently standardised and voluminous at liquid maturity points. This is likely to be a relatively low cost endeavour for exchanges as it would simply require replication of their existing market infrastructures for sovereign debt securities.

4.2.3 Inclusion in benchmark indexes

Passive asset management has become increasingly important in financial markets. The aim of passive investment is to create a portfolio that replicates a benchmark index as closely as possible. Investors buy stakes in the investment fund and enjoy the returns of the tracked index, with generally low management fees. As such, benchmark indexes are a crucial component of the infrastructure underpinning passive asset management.

Market intelligence has identified inclusion in benchmarks as an important feature of SBBS. Inclusion in benchmarks depends on the creators of indexes. These institutions have their own internal rules on the construction of benchmarks and the securities that are eligible for inclusion. Bloomberg is one of the leading index providers for government bonds, along with institutions such as Bank of America, Citi and JP Morgan. Box 4.D describes how Bloomberg's benchmark indexes are constructed and the potential implications for SBBS.

Box 4.D
Bloomberg's benchmark indexes

Bloomberg operates a broad set of European indexes. In fixed income markets, this includes euro treasury (only sovereign bonds), euro government related (supranationals and agencies), euro corporate (corporate bonds) and euro securitised (ABS, MBS, covered bonds). In addition, Bloomberg maintains a euro aggregate index, which comprises the four aforementioned indexes, weighted to reflect the euro fixed income market.

Bloomberg indexes follow the principle that any repackaging of securities that are already included in its indexes is not itself included in the index. The rationale is to avoid double counting securities that are already included in their index universe. For example, CMOs are not included in Bloomberg indexes as they represent a repackaging of MBS, which are included in Bloomberg's euro securitised index. However, the mortgages underlying MBS are not included in Bloomberg's family of indexes, which explains why MBS are themselves included, as they represent a genuinely new security to the Bloomberg index universe. In short, Bloomberg applies a "look-through principle" to avoid including securities in its index more than once.

SBBS are likely to fall in this category as they repackage sovereign bonds that are already included in Bloomberg's euro treasury index. This does not represent discrimination against SBBS: rather, it recognises the fact that SBBS represent a simple repackaging of existing bonds. Passive investors could therefore track Bloomberg's euro treasury index by holding either sovereign bonds directly or by holding a replicating portfolio of senior, mezzanine and junior SBBS. Thus, demand for SBBS from passive investors should be unaffected by Bloomberg's "look-through" approach to the composition of its indexes.

Nevertheless, if the SBBS market were to grow very large, Bloomberg may consider rebalancing its indexes by removing sovereign bonds (at the margin) and replacing them with SBBS. If this were to occur, SBBS could in principle be inserted into the euro treasury or euro securitised index. In making this decision, Bloomberg would evaluate SBBS in more detail. Assigning SBBS to the euro treasury index would be "index neutral" from the perspective of the weightings of the four indexes in the euro aggregate index.

4.2.4 The role of primary dealers

Primary dealers could help to foster liquidity in SBBS, as they do in most existing markets for government and supranational debt securities. Primary dealers generally facilitate primary market activity and ensure a minimum amount of purchases on the primary market, thus helping to avoid placement failures. In addition, primary dealers advise issuers about the quantities and other characteristics of securities to issue over the yield curve. They also act as market-makers on secondary markets by providing two-sided quotes. When flows of buy and sell orders are roughly balanced, primary dealers can facilitate the matching of demand with supply. When orders are more one-sided, primary dealers can act as contrarian investors, thereby mitigating the price impact of panics. Primary dealers can therefore help to maintain orderly market conditions by enhancing liquidity and mitigating price fluctuations.

The market for primary dealer services in the euro area is concentrated in a small group of internationally active institutions. Table 4.5 lists the most active primary dealers in the euro area. Nine institutions are active in at least 10 euro area sovereign bond markets, suggesting that there are significant scope economies in the provision of primary dealer services. All of the major primary dealers in national sovereign bond markets also provide primary dealer services in the ESM bond market. In fact, the ESM is served by 40 primary dealers, which is significantly more than any individual sovereign bond market. This suggests that primary dealers are willing to make markets in supranational debt securities that embed euro area-wide diversification.

Table 4.5
List of primary dealers by coverage of euro area sovereign bond markets

Primary dealer	No. of countries	ESM primary dealer
Barclays Bank Plc	12	Yes
HSBC	12	Yes
Citigroup Global Markets Limited	12	Yes
Société Générale	12	Yes
Deutsche Bank, AG	11	Yes
BNP Paribas S.A.	10	Yes
J.P. Morgan Securities Plc	10	Yes
Goldman Sachs International Bank	10	Yes
Nomura International Plc	10	Yes
Morgan Stanley	8	Yes
Crédit Agricole CIB	6	Yes
Commerzbank AG	6	Yes
Merrill Lynch International	6	Yes
Natixis	6	Yes

Source: Economic and Financial Committee's sub-committee on EU sovereign debt markets.
Note: The table reports the most active primary dealers according to the number of euro area countries for which each bank is approved to provide primary dealer services.

Understanding the incentives facing primary dealers is important in predicting the likely effect of SBBS on their behaviour. In particular, the development of an SBBS market would give rise to two questions concerning primary dealers. First, which monetary and non-monetary incentives are important to induce the participation of primary dealers in bond markets, and how might these incentive structures carry over to the case of SBBS? Second, would the existence of an SBBS market affect primary dealers' participation in existing sovereign bond markets, either positively or negatively? To address these two questions, this section provides more information on primary dealers' incentive structure.

Benefits to institutions acting as primary dealers

Primary dealership is often rewarded directly by DMOs, which offer monetary and non-monetary incentives to primary dealers. DMOs generally offer a range of incentives to selected dealers in compensation for their obligations on the primary market (e.g. primary dealers bid at auctions to buy at least a specified fraction of auctioned debt in one year) and on the secondary market (by acting as market-makers to provide adequate volumes of exchanges and quotations). The incentives that DMOs grant to primary dealers are issuer- and market-dependent, but some general examples include:

- **Lead managers for extraordinary operations (syndicated loans, swaps, buy-backs).** This gives selected primary dealers a position of strength in the market as well as placement fees. Access to extraordinary operations (especially syndicated loans) represents a valuable reward for primary dealers as it is typically granted to only five or six dealers, which can thereby sell (or buy, in the case of buy-back) a substantial quantity of securities.

- **Close relationship with DMOs.** Primary dealers participate in frequent (generally monthly) meetings with DMOs, advising them on issuance strategies, tactical placements and extraordinary operations. A close relationship with DMOs gives an informational advantage to primary dealers.

- **Reserved re-openings (non-competitive auctions).** Primary dealers can sometimes buy securities issued on the primary market on the day of (or some days after) the initial auction at the same allotment price. This privilege constitutes a call option on bills and bonds issued by a DMO. It also provides a way to satisfy excess demand from end investors. Generally, each primary dealer has a share in the reserved re-openings, depending on their activity on primary and secondary markets.

- **Monetary incentives.** Primary dealers often receive fees for their market activity and advisory services, as elaborated in Box 4.E.

Available evidence suggests that both monetary and non-monetary incentives induce primary dealer activity, albeit to varying extents depending on the size of the market. Analysis of primary dealers' activity in the Italian market suggests that monetary incentives are relatively weak (see Box 4.E). Explanatory power is instead provided by variables related to turnover on MTS, which is the most active electronic platform of exchange for Italian government securities. However, experience from smaller government bond markets suggests that monetary incentives can play a role in inducing primary dealer activity. One example is given by the Danish

DMO. Following a significant reduction in government bond market liquidity, the Danish DMO introduced annual payments of up to DKK 25 million (about €3 million) to banks that provide quotes and act as distribution channels for Danish government bonds. This contributed to a more liquid market for Danish government bonds.

In larger markets, sovereign bonds are more likely to be used as collateral in repurchase operations and derivatives transactions. This is consistent with the assessment that non-monetary incentives are likely to dominate in larger markets, where being a primary dealer helps institutions to access securities that can be used in different operations. In smaller markets, however, these non-monetary incentives are likely to be weaker, so fees offered by DMOs become relatively more important.

A large SBBS market is therefore likely to attract numerous primary dealers. As market size increases, the non-monetary incentives of acting as a primary dealer in an SBBS market are likely to dominate insofar as the senior security in particular could be used for other purposes, such as collateral in repo and derivatives transactions. Primary dealership in SBBS could also complement similar activity in existing sovereign bond markets, particularly for multinational institutions that are active across markets. These synergies are likely to be even stronger if the primary dealer function were to overlap with that of SBBS arranger (depending on the issuance model that is adopted for SBBS).

Costs to institutions acting as primary dealers

The introduction of a system of primary dealership for SBBS is likely to have a limited impact on internationally active primary dealers. Such dealers already operate across several national government bond markets due to the presence of significant scope economies. An additional market in the form of SBBS could generate a further source of revenue for primary dealers, particularly if the market were to become large. In fact, SBBS could induce internationally active primary dealers to increase their presence in smaller markets, particularly if SBBS were to be arranged by private-sector institutions (such as primary dealers themselves). By the same token, smaller primary dealers operating only in their domestic sovereign bond market could conceivably be hurt by the introduction of SBBS, as their competitive advantage would be weakened by greater integration of national markets.

The regulation of SBBS, including capital and liquidity requirements, would affect primary dealers' incentives. Primary dealers need to maintain inventories to provide bonds on demand. As such, high inventory costs – including those related to regulation – can negatively affect primary dealer participation and therefore the liquidity of underlying assets. Dealer activity in bonds with little credit risk, such as senior SBBS, is affected by the leverage ratio requirement in particular (Committee on the Global Financial System, 2014). However, there is limited evidence that leverage ratio requirements bind in the EU – they are of greater significance for broker-dealers in the United States (Office of Financial Research, 2015). Risk-weighted capital requirements are instead more relevant for bonds with non-zero capital requirements, such as mezzanine and junior SBBS. Nevertheless, there is evidence that tighter regulatory requirements help to bolster liquidity conditions in severe crises, even if they reduce liquidity in normal circumstances (Baranova, Liu and Shakir, 2017).

Careful consideration should be given to the balance sheet capacity available for primary dealers to make markets. Market-making needs balance sheet capacity to guarantee quotes, requiring repurchase operations, short-selling and inventory. Balance sheet capacity is to some extent a fixed cost for primary dealers insofar as they need to maintain minimal inventories regardless of market size. In this sense, a possible concern is that the introduction of SBBS could crowd out primary dealership in smaller markets owing to finite balance sheet capacity. However, no evidence for such a crowding-out effect has been observed in the development of the ESM bond market, which has attracted more primary dealers than any individual national sovereign bond. In fact, in the case of SBBS, an opposite crowding-in effect might also be present, as SBBS could be combined to hedge price movements in sovereign bonds, as shown in Section 4.4.2. In addition, there may be natural synergies between primary dealer activity in SBBS and similar activity in national sovereign bond markets, particularly if primary dealers were also SBBS arranger(s).

Box 4.E
Monetary incentives for primary dealers

This box draws on an analysis of the Italian sovereign debt market undertaken by Bufano et al (2018). Italy is used as case study to understand the role of monetary incentives facing primary dealers. Although instructive, the results of the study cannot necessarily be generalised, as the size and microstructure of sovereign debt markets varies substantially across countries.

Monetary incentives for primary dealers generally fall into three categories:

- Revenue from participation in auctions arising from the difference in the auction price and the price paid by the final buyer. These revenues are broadly distributed across auction participants (not only primary dealers).
- Fees granted when acting as lead-managers in syndicates (which are typically used to place the first issue of less liquid bonds such as inflation-indexed and plain-vanilla bonds with maturities of more than 15 years). Managing a syndicated loan gives several rewards to primary dealers, including a commission for the security's placement. This commission is split among four or five primary dealers rather than all auction participants (generally around 20). In Italy, the average size of syndicated loans (€6.5 billion) is comparable to the largest private placements of corporate bonds, making them attractive to primary dealers.
- The economic value of the option to participate in re-openings (also called "supplementary auctions") of the previous day's ordinary auction. DMOs restrict re-opening offers to primary dealers, which have the option to bid at the price set in the auction on the previous day. The value of this option depends on the difference between the previous day's auction price and the current secondary market price, as well as the re-opening amount, which varies depending on the characteristics of the security.

This box assesses the importance of monetary incentives in inducing primary dealer activity. The focus is on the third incentive listed above, namely the value of the call option. The analysis reveals that variation in the value of this option does not induce primary dealers to change their bidding behaviour. Instead, bidding behaviour reflects non-pecuniary factors such as primary dealers' efforts to maintain relationships with DMOs and clients.

Details of the analysis

The option value of re-openings is assessed using confidential auction data from 2005 to 2015. Since re-openings are essentially call options on the bond that was auctioned on the previous day (with a strike price equal to the allotment price of the auction), their monetary value can be quantified as the difference between the allotment price and the bid price on the secondary market when the re-opening is executed. In the analysis conducted here, the realised value of the option is used as a proxy for its ex ante value. This approximation is justified by the assumption that primary dealers have an unbiased expectation of the future value of the re-opening.

To calculate the realised value of re-openings, auction price data are compared with MTS price data on the following day. This permits quantification of the benefit of selling the bond on the secondary market after buying it in the re-opening at a below-market price. The realised value of the re-opening to a primary dealer is obtained by computing this price difference and multiplying it by the quantity offered by the DMO in the re-opening. The value of the re-opening can be either positive or negative, depending on the direction of secondary market price movements after the ordinary auction. This box focuses on the option value of three-, five-, seven- and 10-year Italian sovereign bond issuances, as these notes are offered frequently and have a higher option value due to their longer duration.

The realised value of re-openings is stochastic. If the secondary market price rises above the allotment price, the value of the re-opening option on the following day will be positive. Otherwise, if the secondary market price falls below the allotment price, the re-opening option has no value to primary dealers, as it would theoretically be cheaper for them to obtain the bond in the secondary market. Therefore, one would expect the option to be exercised only in the first case. To test this hypothesis, Table A reports the frequency with which primary dealers exercise their option to participate in the Italian DMO's re-openings of ordinary auctions. The hypothesis implies that the elements on the main diagonal of Table A would take the value of 100% and those off-diagonal 0%. While it is indeed the case that the main diagonal elements are higher than those off-diagonal, all elements lie somewhere between 0% and 100%. This behaviour suggests that financial frictions – such as low levels of liquidity in the secondary market, meaning that large orders move prices – might inhibit dealers from fully capitalising on re-openings. It could also be due to dealers' reluctance to trade on secondary markets in a way that reveals their proprietary investment strategy. Regardless of the explanation, it seems that the immediate potential value of participating in re-openings does not dominate primary dealers' decision-making.

Table A

Exercise frequency of the re-opening option

	$P_{ord} < P^{BID}$	$P^{BID} \leq P_{ord} \leq P^{ASK}$	$P_{ord} > P^{ASK}$
Full exercise	64.0	51.1	13.0
Partial exercise	3.9	40.4	50.0
No exercise	32.2	8.5	37.0

Source: Bank of Italy, MTS and ESRB calculations.
Note: The table shows the frequency with which primary dealers participate in re-openings (in percent). P_{ord} is the allotment price in the ordinary auction and P^{BID} and P^{ASK} are the bid and ask prices on the secondary market on the day of the re-opening. Auction prices are from Bloomberg and secondary market prices are from MTS.

The panel regression model

A panel regression model is estimated to quantify the importance of monetary incentives granted by the Italian DMO to primary dealers. The dependent variable of the panel regression model is the amount bid by primary dealer *i* in a given auction. This variable is regressed on:

- **Spread of Italian over German government bonds** to capture financial conditions in the Italian government bond market on the day of the ordinary auction.
- **Amount offered by the DMO in the ordinary auction** to control for heterogeneity in auction volumes (e.g. higher amounts are typically offered for first issues).
- **Total amount exchanged on MTS** to proxy for liquidity levels in the secondary market on the day of the re-opening.
- **Amount bought and sold by each dealer on MTS** to measure the activity of each primary dealer on the secondary market on the day of the re-opening
- **Re-opening option value** to measure the realised value to the dealer of the option to access a re-opening of the previous day's auction.

Table B shows the descriptive statistics of these variables and Table C reports the results of the panel regression. In the regression, explanatory power is provided by variables relating to the amount offered by the DMO in the ordinary auction and turnover on the secondary market organised by MTS. However, there is no evidence of a relationship between primary dealers' participation at auctions and the monetary incentives captured by the value of the dealer's option to participate in a re-opening of the previous day's auction.

One possible explanation for these findings is that monetary incentives are too low to affect primary dealer bidding behaviour. Primary dealers seem to value non-pecuniary benefits from participating in re-openings, such as maintaining relationships with DMOs and clients, more than the direct monetary gain they derive from it. On this interpretation, participation in supplementary auctions is guided more by long-term strategic considerations than immediate monetary gain.

Table B

Descriptive statistics of variables used in the panel regression model

(asterisks denote amounts in millions of euro)

	Amount bid by dealer *i*	Spread	Amount offered by DMO	Total amount exchanged on MTS	Amount sold by dealer *i* on MTS	Amount bought by dealer *i* on MTS	Re-opening option value
Mean	212*	176.42	3030*	233*	10.98*	11.75*	0.07
Median	195*	146.90	3000*	194*	0.00	0.00	0.03
Maximum	2530*	510.50	5500*	1650*	400*	651*	2.30
Minimum	0.00	19.80	395*	0.00	0.00	0.00	-2.48
Std. Dev.	110*	118.74	808*	222*	23.05*	25.24*	0.44
Skewness	4.54	0.85	-0.22	2.04	5.056	6.17	-0.01
Kurtosis	57.98	2.91	4.12	10.07	47.93	91.88	9.44
Jarque-Bera	0.76*	711.99	353.41	16382.33	0.52*	1.98*	10215.13
Observations	5907	5907	5907	5907	5907	5907	5907

Source: Bloomberg, Bank of Italy, MTS and ESRB calculations.
Note: The table reports descriptive statistics of variables used in the panel regression model.

Table C

Panel regression results

Dependent variable: amount bid by dealer *i* in re-opening	(1)	(2)	(3)
Spread	2.21**	2.21**	2.17*
Amount offered by DMO	0.06***	0.06***	0.06***
Total amount exchanged on MTS	-0.02***	-0.02***	-0.02***
Amount sold by dealer *i* on MTS	0.11*	0.23**	
Amount bought by dealer *i* on MTS	0.21**		0.14**
Re-opening option value	-1.87	-1.87	-1.87
Constant	16.85***	16.84***	17.23***
No. observations	5,907	5,907	5,907
R-squared	0.22	0.22	0.22

Source: Bank of Italy, MTS and ESRB calculations.
Note: The table reports the results of a panel regression model with amount bid by primary dealer i in a given auction as the dependent variable. Single, double and triple asterisks denote statistical significance at the 10%, 5% and 1% confidence levels respectively.

4.3 Development of the SBBS market

A well-functioning SBBS market needs to be large enough to have an impact and ensure adequate liquidity, but not so large as to negatively affect national sovereign debt markets. This section sketches the possible development of an SBBS market in the light of recent experiences in sovereign bond markets. In particular, lessons can be learned from the development of the European Financial Stability Facility (EFSF) and ESM bond markets and from the implementation of the Eurosystem's PSPP. These policy experiences suggest that the SBBS market should be developed incrementally in its early years. Following this early development phase, policymakers could allow the SBBS market to increase in size if sovereign debt markets continue to function smoothly. On this basis, an illustrative SBBS issuance calendar is defined with the objective of minimising the impact on DMO issuance strategies. In the longer-run, limits on SBBS steady-state market size could be guided by issuer share purchase limits (somewhat similarly to the Eurosystem's PSPP). If investors demonstrate substantial interest in SBBS, the market could grow to €1.5 trillion or more, depending on the observed impact on sovereign bond market liquidity.

4.3.1 Incremental market deepening

The SBBS market should be developed incrementally in the initial phase (following the removal of current regulatory barriers). A useful benchmark for an effective incremental development of the SBBS market is provided by the issuance of EFSF and ESM bonds, for which a relatively liquid market has developed (see Box 4.F). These securities trade at small interest rate premia to German and Dutch central government bonds and below French government bonds, despite having a much smaller market turnover. Based on iTraxx data, the current average monthly secondary market trading volume is around €4 billion for German government bonds, €2.5 billion for French bonds and €500 million for Austrian, Irish and Portuguese bonds, compared with €150 million for EFSF and ESM bonds. The EFSF placed €16 billion of long-term marketable debt securities in the first year of its issuance in 2011. Similarly, the ESM issued €10 billion of long-term marketable debt securities when it began issuing in 2013 (see Box 4.F). To create a comparably large market for senior SBBS in the first year, overall SBBS issuance would need to be approximately €24 billion (given that non-senior SBBS would also need to be placed). Lessons from the EFSF and ESM about the market microstructure of a successful issuance programme could be applied to the development of an SBBS market.

The underlying portfolio could be assembled in primary or secondary markets (or both). Nevertheless, to quantify the impact of a yearly programme of €24 billion in gross SBBS issuance, it is assumed here that purchases take place on primary markets. Based on 2016 issuance, €24 billion of SBBS issuance could be achieved by purchasing 3% of DMO annual issuance of debt securities (see Table 4.6).[45] This relatively small fraction would allow DMOs to meet their idiosyncratic cash flows with the remaining 97% of calendar year issuance. As such, the timing and

[45] This numerical exercise is indicative, as it assumes that DMO issuance in 2016 is representative of future issuance.

characteristics of the 3% intended for SBBS could be subject to enhanced coordination, which would assist in the assembly of the underlying portfolio by SBBS arranger(s).

Table 4.6

SBBS primary market purchases at 3%, 5% and 10% of annual DMO issuance in 2016

(in € billions)

Country	3% of 2016 issuance	5% of 2016 issuance	10% of 2016 issuance
Austria	0.7	1.2	2.3
Belgium	0.9	1.5	2.9
Cyprus	0.0	0.1	0.1
Germany	6.3	10.5	20.9
Spain	3.1	5.2	10.4
Finland	0.4	0.7	1.5
France	5.0	8.3	16.6
Ireland	0.4	0.7	1.4
Italy	4.3	7.2	14.4
Lithuania	0.1	0.1	0.2
Latvia	0.0	0.1	0.1
Malta	0.0	0.0	0.1
Netherlands	1.4	2.3	4.7
Portugal	0.6	1.0	2.0
Slovakia	0.1	0.2	0.4
Slovenia	0.2	0.3	0.6
Total	**23.6**	**39.3**	**78.6**

Source: Bloomberg and ESRB calculations.
Notes: The table refers to the quantity of annual purchases of central government debt securities per country by the SBBS-issuing entity or entities. Three scenarios are envisaged: first, purchases amount to 3% of euro area-wide annual DMO issuance (based on 2016 data); second, purchases amount to 5%; and third, purchases amount to 10%. In these cases, total SBBS issuance would be €23.6 billion, €39.3 billion and €78.6 billion respectively. Given the lack of issuance from central governments in three euro area countries during 2016, this simulation is based on volumes for the 16 central governments that did in fact issue debt in that year. To ensure a fully diversified underlying pool, purchases on secondary markets could replace those on primary markets for countries without issuance.

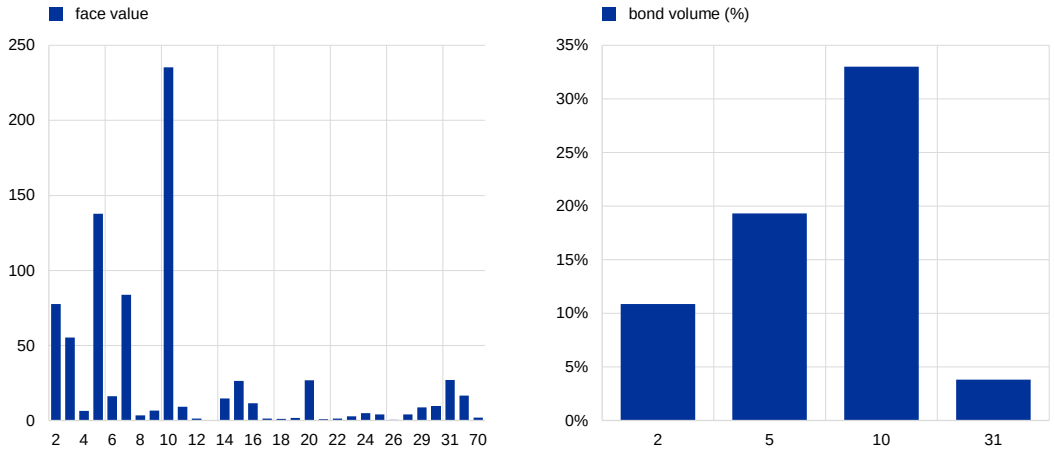
The issuance of SBBS should focus on the most liquid points in the early phase of market development, with the aim of gradually building a yield curve for SBBS. For example, if arranger(s) aspire in a given year to arrange for the issuance of SBBS maturing in two, five and 10 years with each series being issued in January, March, June and September respectively, the arranger(s) would buy the same maturity bonds from DMOs (e.g. by private placement) in these months. European DMOs already engage in private placements of bonds; doing the same for SBBS arranger(s) would not lie outside their sphere of operations. Supranational agencies (such as EFSF or ESM) also issue bonds directly to investors. Moreover, DMOs would continue to issue the remaining (large majority) of their debt based on current practices. Hence, the SBBS-issuing entities should only issue SBBS that mature on dates that coincide with significantly large volumes of bonds. The right-hand panel of Figure 4.3 illustrates such a term structure. Such an SBBS curve

would be robust, as it would draw from 60% of total new bonds issued each year – i.e. €480 billion out of a total of €800 billion in 2016.

Figure 4.3

Maturity profile of euro area central government bond issuance in 2016 (left-hand panel) and indicative maturity profile of SBBS (right-hand panel)

(in € billions in left-hand panel; percent in right-hand panel)



Source: Bloomberg and ESRB calculations.
Note: The figure shows the original maturity profile of euro area central government bond issuance in 2016 (left-hand panel) and an indicative maturity profile of SBBS (right-hand panel). In the early phase of SBBS market development, issuance would focus on the most liquid maturity points, with a longer-term aim of gradually building a yield curve for SBBS.

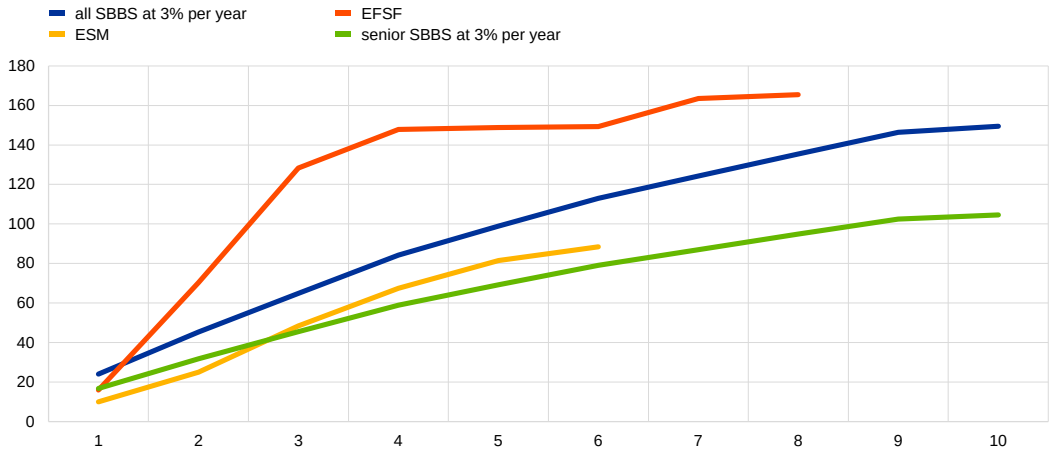
The initial incremental development of the SBBS market could take one or several years. By way of illustration, Figure 4.4 plots growth in the EFSF and ESM bond markets in their first years against a scenario for SBBS market development in which purchases take place at a rate of €24 billion per year (i.e. 3% of DMO annual issuance of sovereign debt). At this rate, and assuming the SBBS maturity profile shown in Figure 4.3, the SBBS market would amount to €99 billion after five years, which compares with an EFSF bond market of €149 billion after five years and an ESM bond market of €81 billion over the same period.

The comparison with EFSF and ESM bond markets suggests that an SBBS programme of similar size could achieve similar levels of liquidity. Nevertheless, EFSF and ESM bonds are different securities to SBBS, which might imply different levels of liquidity for a given market size. Unlike the EFSF and ESM bond markets, the SBBS market would be divided into senior, mezzanine and junior components. With a 70%-thick senior security, a €99 billion SBBS market would comprise €69 billion of senior SBBS. In view of this, and to reap the full benefits of a large SBBS market, policymakers could choose to ramp up growth after initial SBBS market development, conditional on sufficient investor demand.

Figure 4.4

SBBS market development assuming that purchases amount to 3% of annual DMO issuance (i.e. €24 billion per year) compared with ESM and EFSF bond market development

(vertical axis is in € billions; horizontal axis is in years)



Source: ESM and ESRB calculations.
Note: The figure shows the value of outstanding (senior) SBBS in the first years of market development (assuming an SBBS issuance programme amounting to 3% of annual DMO issuance (i.e. €24 billion per year) compared with ESM and EFSF bond market development.

Box 4.F

EFSF and ESM: case studies in market development

The experience of the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM) is relevant to SBBS in terms of the market microstructure of setting up a successful issuance programme. Nevertheless, these supranational bonds entail a different type of credit enhancement: while SBBS embed contractual subordination, EFSF and ESM bonds feature over-guarantees and subscribed capital that exceeds lending capacity (and a unique capital call mechanism in the case of the ESM).

The EFSF and ESM have established themselves as successful supranational issuers. The two issuers raised significant amounts in capital markets at a low cost over a short period (starting in 2011 for the EFSF) thanks to carefully managed funding and investor relations activities.

The ESM's high credit ratings (see Table A) are achieved through euro area Member States' willingness and ability to provide support in combination with the institution's standalone credit strengths. As strong points, CRAs emphasise the ESM's large capital base, low leverage, unique capital call mechanism and prudent risk management. The EFSF's credit ratings (see Table B) rely on guarantors' support in the form of irrevocable, unconditional and timely guarantees, as well as a credit enhancement ensuring that bond payments are fully covered by credible guarantees.

Table A

ESM ratings

Fitch			Moody's			DBRS (unsolicited)		
Long-term rating	Short-term rating	Rating outlook	Long-term rating	Short-term rating	Rating outlook	Long-term rating	Short-term rating	Rating trend
AAA	F1+	Stable	Aa1	P-1	Stable	AAA	R-1 (high)	Stable

Source: Fitch, Moody's and DBRS.
Note: The table shows the credit ratings assigned to the ESM.

Table B

EFSF ratings

Fitch			Moody's			Standard & Poor's			DBRS (unsolicited)		
Long-term rating	Short-term rating	Rating outlook	Long-term rating	Short-term rating	Rating outlook	Long-term rating	Short-term rating	Rating outlook	Long-term rating	Short-term rating	Rating trend
AA	F1+	Stable	Aa1	P-1	Stable	AA	A-1+	Stable	AAA	R-1 (high)	Stable

Source: Fitch, Moody's, S&P and DBRS.
Note: The table shows the credit ratings assigned to the EFSF.

Secondary market liquidity is key for frequent issuers such as the EFSF and ESM. For regulatory purposes, it is thus important that their bonds are recognised as assets with high liquidity. The bonds are also eligible collateral with clearing platforms such as Euroclear and Eurex and eligible for use in monetary policy operations of the ECB and non-euro area central banks (UK, Switzerland).

The EFSF and ESM conduct primary market activities based on continuous monitoring and analysis of secondary markets. For this purpose, the ESM has implemented a regular reporting system with a broad primary dealer group. The ESM comprehensively monitors liquidity in terms of turnover volume, bid-ask spreads, average trade size, price and turnover volatilities, specific flows between counterparty types and regions, and other indicators. To maintain liquidity and attract investors, the EFSF and ESM have a flexible funding strategy with regular issuances of benchmark transactions on all parts of the yield curve (from maturities of three and six months to maturities of 45 years). These issuances are large with outstanding amounts of around €5 billion, ensuring regular secondary market trading. Furthermore, the EFSF and ESM further support market liquidity by regularly increasing amounts on existing bonds through tap issuances using auctions, which is unique in the market for supranational debt.

A core element of the investor relations strategy is to provide clear and consistent information on issuance amounts and timing, which are communicated to the market in quarterly newsletters. The ESM attends industry conferences and organises investor roadshows, which creates relationships, supports collaboration and enables the adaptation of the funding strategy to investor demands.

4.3.2 SBBS issuance calendar

The incremental deepening of the SBBS market should be calibrated in a way that minimises potential adverse effects for the functioning of sovereign bond markets. To that end, this section considers the maturity selection and timing of SBBS issuance in the context of heterogeneity in national sovereign debt issuance calendars. It sketches a possible SBBS issuance calendar that takes into account differences in the financing needs of participating Member States.

Heterogeneity in the SBBS cover pool would be minimised by DMOs reserving some fraction of their primary market issuance for SBBS arranger(s). Under this issuance model, DMOs would place securities directly with arranger(s) on an SBBS-specific trading venue (see Section 4.1.3). DMOs could coordinate the placement of securities with SBBS arranger(s) in a way that reflects their collective funding needs. A frequently voiced concern about this issuance model is that countries would need to depart from their preferred timing of issuance. Countries have different liabilities that mature at different times within a given year; issuance of debt is carefully timed to match the idiosyncratic expiry of these liabilities. The historical issuance calendars of DMOs provide lessons about the quantitative importance of this concern. In particular, they allow an exploration of whether and how an SBBS issuance calendar could be designed so as to minimise differences in funding needs across countries. The guiding principle is to design the calendar to reflect DMOs' revealed preferences regarding the timing, characteristics and volume of their issuance. Nevertheless, is should be borne in mind that SBBS arranger(s) need not operate in primary markets at all, as it would also be possible for them to assemble cover pools in secondary markets, as Section 4.1.3 explains.

Cross-country heterogeneity in the timing of debt issuances and their original maturity is relatively limited in the euro area. To show this, Figure 4.5 plots on the vertical axis the average time in days between bond issuances by different countries. Different original maturities are shown on the horizontal axis. Distance is minimised for bond maturities of 10 years, for which the average distance stands at 12 days. For five-year bonds, the average distance is 18 days. This analysis indicates that – for the most liquid maturity segments – DMOs would only need to adjust their issuance calendars by a week or two on average for the purposes of issuing debt securities earmarked for inclusion in SBBS.

The analysis underpinning Figure 4.5 is conducted as follows. The number of days between the issuance dates of bond issuances in the same maturity bucket from different countries are counted using 2014-16 issuance data from 10 euro area countries. The 10 countries in the sample are then divided into unique pairs (10C2 = 45 unique pairs). For each country pair, and within each maturity bucket, the algorithm answers the question: "after one country issues a bond of a certain maturity, what is the number of days that passes until its country pair issues a bond of the same maturity?" A long gap between issuance dates corresponds to high cross-country heterogeneity in debt market issuance. Within each maturity bucket, the algorithm generates 45 data points that quantify the average distance between issuance dates of bonds between country pairs. The average of these 45 distances provides an aggregate measure of issuance date distance across all countries in the sample. This process is carried out 70 times (for all maturity points between one and 70 years), and is summarised in Figure 4.5.

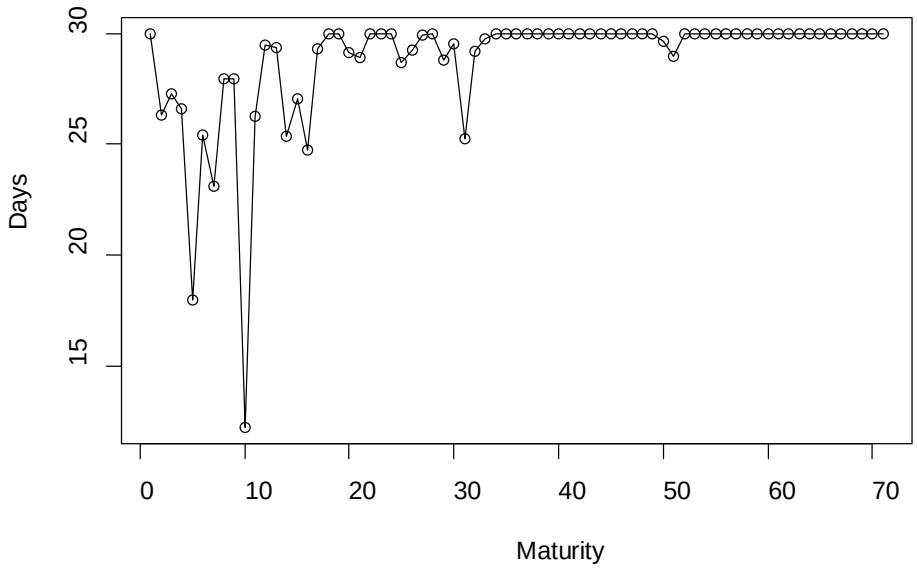
This analysis supports the view that the incremental development of an SBBS issuance programme could focus on issuance at the most liquid points, notably five and particularly

10 years. At these points, issuance calendars are already relatively homogenous across countries. This does not hold for non-liquid maturity points. SBBS issuance at "broken" maturity points would therefore require greater flexibility from DMOs (if the issuance model of "SBBS-specific ISINs" is adopted). From a DMO perspective, SBBS issuance at standard maturity points would therefore be preferable, as it would imply less disruption to DMOs' revealed preference in issuance timing.

Figure 4.5

Cross-country heterogeneity in primary market issuance dates by original maturity

(vertical axis measures time (in days); horizontal axis measures maturity (in years))



Source: Bloomberg and ESRB calculations.
Note: The figure plots the average time (in days) between issuance of national sovereign bonds on the vertical axis against debt issuance at different original maturities (in years) on the horizontal axis. Time is minimised at the 10-year maturity point.

Tables 4.7 and 4.8 outline a possible SBBS issuance calendar designed to minimise the impact on DMOs, based on 2016 issuance data and focusing on five- and 10-year maturities. At the 10-year maturity, SBBS issuance could have taken place on three dates in 2016: 4 April, 6 July and 5 October (see Table 4.7, Panel A). On or near these dates, the 10 largest euro area countries issued a total of €70 billion in 10-year debt securities (i.e. 30% of total 10-year issuance during 2016). If some or all of this €70 billion had been packaged into SBBS via coordinated primary market issuance, DMOs would have needed to change their issuance dates by a median of six days relative to their actual issuance date. The picture is similar for five-year debt instruments, for which SBBS issuance could have taken place on three dates in 2016: 30 March, 30 June and 29 September (see Table 4.7, Panel B). On or near these dates, the 10 largest euro area countries issued a total of €55 billion in five-year debt securities (i.e. 38% of total five-year issuance in 2016), some or all of which could have been packaged into SBBS instead. If this had occurred, DMOs would have needed to change their issuance dates by a median of eight days relative to their actual issuance dates, although some would have needed to make more significant calendar adjustments.

Table 4.7

Panel A: Indicative 10-year SBBS issuance calendar

	SBBS issuance date: 04/04/2016			SBBS issuance date: 06/07/2016			SBBS issuance date: 05/10/2016		
	Issuance date	Distance (in days)	Size (€ bn)	Issuance date	Distance (in days)	Size (€ bn)	Issuance date	Distance (in days)	Size (€ bn)
Austria	09/02/2016	40	0.7	05/07/2016	2	0.6	11/10/2016	5	0.8
Belgium	18/04/2016	-10	1.2	18/07/2016	-9	1.2	19/09/2016	-13	2.8
Finland	01/03/2016	25	4	14/06/2016	17	1	-	-	-
France	07/04/2016	-3	4.5	07/07/2016	-2	3.6	06/10/2016	2	3.2
Germany	20/04/2016	-12	4	13/07/2016	-6	5	05/10/2016	1	4
Ireland	14/04/2016	-8	0.8	08/09/2016	-47	1	13/10/2016	7	1
Italy	30/03/2016	4	3	30/06/2016	5	2.9	29/09/2016	-5	2.9
Netherlands	22/03/2016	10	5.7	12/07/2016	-5	2.4	11/10/2016	5	1.9
Portugal	11/05/2016	-27	1.4	13/07/2016	-6	0.6	31/08/2016	-26	0.6
Spain	07/04/2016	-3	1.6	18/07/2016	-9	6	06/10/2016	2	1.5
Total			**26.9**			**24.3**			**18.7**

Panel B: Indicative five-year SBBS issuance calendar

	SBBS issuance date: 30/03/2016			SBBS issuance date: 30/06/2016			SBBS issuance date: 29/09/2016		
	Issuance date	Distance (in days)	Size (€ bn)	Issuance date	Distance (in days)	Size (€ bn)	Issuance date	Distance (in days)	Size (€ bn)
Austria	-	-	-	-	-	-	-	-	-
Belgium	-	-	-	-	-	-	-	-	-
Finland	19/01/2016	-71	1	19/01/2016	-163	1	-	-	-
France	17/03/2016	-13	6.7	16/06/2016	-14	3.3	15/09/2016	-14	4.4
Germany	30/03/2016	0	4	20/07/2016	20	5	21/09/2016	-8	4
Ireland	-	-	-	-	-	-	-	-	-
Italy	30/03/2016	0	4.2	30/06/2016	0	2.9	29/09/2016	0	4
Netherlands	-	-	-	13/09/2016	75	3.2	13/09/2016	-16	3.2
Portugal	23/03/2016	-7	0.5	08/06/2016	-22	0.6	26/10/2016	27	1
Spain	07/04/2016	8	0.9	07/07/2016	7	2.3	06/10/2016	7	2.4
Total			**17.3**			**18.3**			**19**

Source: Bloomberg and ESRB calculations.
Note: The table shows an indicative calendar for the issuance of SBBS in 2016. Panel A reports an indicative calendar for 10-year bond issuance and Panel B reports an indicative calendar for five-year issuance. At each of these maturity points, issuance could have taken place on the three dates shown in the top row of Panel A and Panel B. These three sets of dates are chosen as the mid-point of the issuance dates of national sovereign bonds at the respective maturities. In each panel, the issuance date column indicates the closest respective date on which a country issued a bond at the respective maturities; the distance column indicates the distance in days between that date and the SBBS issuance date; and the size column reports issuance size in billions of euro. Missing observations indicate that the country did not issue a bond at the given maturity within three months of the respective SBBS issuance date.

A downside of this approach to SBBS issuance is that it places a cap on the yearly issuance of SBBS. To overcome this limitation, DMOs could adopt greater flexibility in adjusting their issuance dates. SBBS arranger(s) would then be free to devise a calendar of their own preference, reflecting market demand. The constraint on SBBS market development would then be given by the amount of bonds issued by each country relative to its portfolio weight. Table 4.8 sheds light on the SBBS market size that each country's SBBS portfolio weight and issuance volume would allow at the five and 10-year points. For example, the binding constraint on SBBS market size at the 10-year mark is Portugal, which issued €2.6 billion of 10-year debt in 2016 and has an SBBS portfolio weight of 2.55%. As such, even if all of Portugal's 10-year debt issued in 2016 were included in SBBS, the total volume of 10-year SBBS that could have been issued in that year out of primary market issuance is €102 billion. Beyond this level, SBBS arranger(s) would either need to obtain 10-year Portuguese debt in secondary markets, or begin to underweight Portugal in the cover pool. Alternatively, Portugal may be induced to issue relatively more 10-year debt securities to satisfy latent demand from SBBS arranger(s).

The issuance of debt securities at non-standard maturity points is more heterogeneous across countries. The five- and 10-year points are typically the most liquid in sovereign bond markets. Volumes of issuance tend to be more heterogeneous across countries at less standard points along the yield curve. In the absence of greater coordination among DMOs, this cross-country heterogeneity at non-standard maturity points would frustrate the ability of SBBS arranger(s) to assemble sovereign bonds in primary markets. As such, for some SBBS issuances at non-standard maturities, SBBS arranger(s) may need to operate in secondary markets to assemble a cover pool with the necessary cash flow profile.

Table 4.8

Sovereign bond issuance by country in 2016

	SBBS portfolio weight (%)	Five-year issuance in 2016 (€ billions)	10-year issuance in 2016 (€ billions)
Austria	2.88	0.7	5
Belgium	3.63	1	10
Finland	1.84	1	5
France	20.78	41.2	56.9
Germany	26.15	40	54.5
Ireland	1.70	0.8	6.8
Italy	18.04	33.7	39.5
Netherlands	5.87	3.2	15.2
Portugal	2.55	3.2	2.6
Spain	12.96	23.9	38.6

Source: Bloomberg and ESRB calculations.
Note: The table shows the notional amounts of five- and 10-year bonds issued in 2016 alongside each country's weight in the SBBS portfolio.

4.3.3 Steady-state market size

Higher issuance volumes would be possible insofar as the SBBS market does not damage the functioning of sovereign debt markets. For example, increasing the yearly rate of primary market purchases from 3% to 10% of DMO annual issuance would imply an increase in gross SBBS issuance from €24 billion to €80 billion. At the latter rate, the SBBS market would amount to €500 billion after 10 years, which is considerably larger than most euro area sovereign debt markets.

To reap the full benefit of SBBS, policymakers may opt to expand the market beyond these volumes, conditional on sufficient investor demand. Enlarging the market would also help to make SBBS more attractive for investors focused on short-term transactions, for whom the smaller volumes may not guarantee enough liquidity. More importantly, SBBS are intended as an asset that facilitates diversification and de-risking. One of the primary motivations for this activating this latent process is the home bias in banks' holdings of sovereign debt. Therefore, a sizeable fraction of banks' current holdings of sovereign debt would need to be replaced by holdings of senior SBBS for the initiative to achieve its intended effect. The €1.9 trillion face value of banks' general government debt holdings thus provides an illustration of the order of magnitudes necessary to reap the full benefits of SBBS.

The SBBS market could be expanded by means of a large-scale portfolio swap (e.g. through an auction mechanism) alongside primary market purchases. Limited issuance is useful in the early years of market development, but it cannot leverage the full benefits of SBBS, which arise from investors' ability to diversify and de-risk their portfolios by purchasing senior SBBS. One option for enlarging the market could be to arrange for a large-scale portfolio swap of SBBS for sovereign bonds. Bank and non-bank participants would submit bids; after the auction, SBBS issuers would hold the underlying sovereign bonds, banks would have (senior) SBBS, and non-bank investors would acquire primarily the mezzanine and junior SBBS. The SBBS market could achieve critical mass following the large-scale swap.

A key principle of SBBS is that primary and secondary market liquidity in sovereign debt markets should not be adversely affected, since efficient price discovery is critical for SBBS issuers to make use of a reliable market price when assembling the underlying portfolio. If the "free float" of actively traded bonds on the secondary market were to shrink too much, sovereign debt markets could become illiquid, resulting in higher premia. Such an effect is highly undesirable, as it drives up financing costs and, in the worst case might make it hard for countries to access capital markets. As such, policymakers may wish to control the maximum size of the SBBS market, despite the policy benefits associated with a large market.

To maintain effective price discovery in national markets, SBBS could be constrained to include no more than a certain fraction of the outstanding central government bonds issued by each Member State. A somewhat similar "issuer limit" is implemented in the PSPP, which constrains the Eurosystem to buying no more than 33% of a country's total outstanding debt and no more than 50% of EU supranational bonds. According to the ECB, these issuer limits are intended as 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. Drawing a parallel with the PSPP, an issuer limit could be introduced to specifically maintain market functioning and price formation in national sovereign bond markets. The PSPP concern about dominant creditor status

does not apply in the case of SBBS, however, since the issuing entities do not hold any residual claim on sovereign bonds, and their formal voting rights would be assigned either to a third-party trustee or to SBBS investors themselves, as discussed in Section 2.

In broad analogy with the Eurosystem's PSPP, the issuer limit could be set at 33% or 50%, depending on liquidity conditions. In the long-run – when the Eurosystem's PSPP holdings are presumably diminished – the application of a 33% or 50% issuer limit for SBBS implies that SBBS issuance would be no worse in terms of its impact on market liquidity than the recent and ongoing implementation of the PSPP by the Eurosystem (see Section 4.4.1).

With an issuer limit of 33%, a reasonable steady-state size of the SBBS market would be €1.5 trillion. At this level, there would be relatively little deviation from the ECB capital key, namely 2.74 percentage points (p.p.) in total, which is less than the 5.77 p.p. of deviation in the Eurosystem's holdings of sovereign bonds under its PSPP. The 2.74 p.p. of total deviation in an SBBS programme of €1.5 trillion is driven by Greece (which would be underweighted by 1.34 p.p.), Slovakia (0.32 p.p.), Lithuania (0.31 p.p.), Estonia (0.27 p.p.), Latvia (0.27 p.p.), Luxembourg (0.15 p.p.) and Cyprus (0.08 p.p.) owing to the scarcity of outstanding sovereign bonds issued by these countries relative to their share in the ECB capital key. Underweighting of Germany would begin when the SBBS market reaches €1.53 trillion, after which total deviation from the ECB capital key increases more quickly as a function of SBBS market size, as Figure 4.6 indicates.[46] As such, to maintain proximity to the ECB capital key, an issuer limit of 33% implies a cap on SBBS market size of approximately €1.5 trillion. With a higher issuer limit of 50%, as used for supranational debt in the Eurosystem's PSPP, the SBBS market could grow to approximately €2.6 trillion without deviating from ECB capital key weights more substantially than under the Eurosystem's PSPP. An SBBS market of €2.6 trillion would be more conducive to the objectives of SBBS, but would lead to a larger "freezing effect" on sovereign bond market liquidity, as discussed in Section 4.4.1.

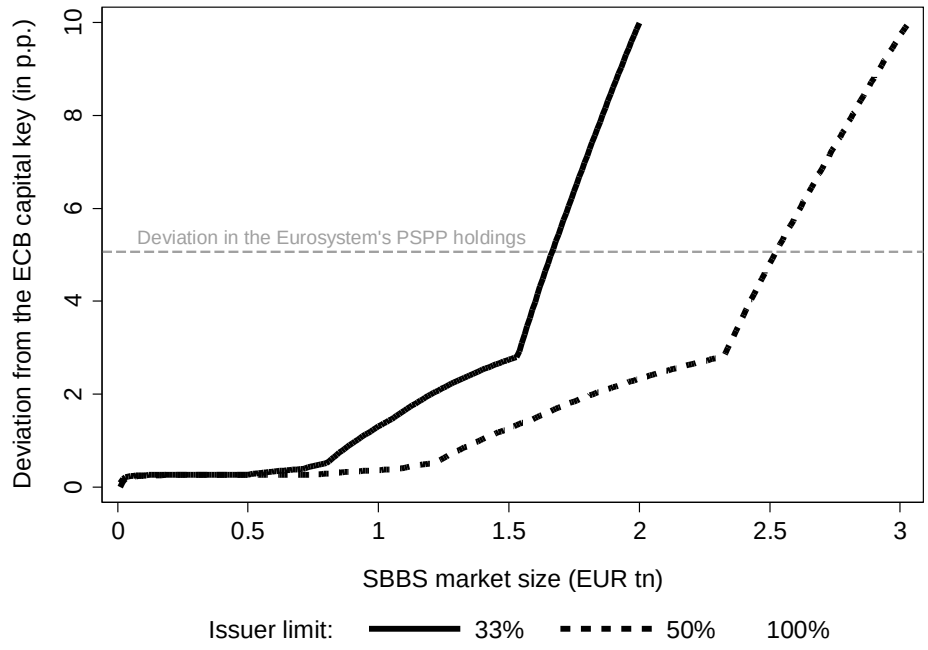
The Eurosystem's PSPP provides only a guide to SBBS market development; depending on the observed effect on liquidity, SBBS market size could exceed €2.6 trillion subject to investor demand. As the SBBS market grows, there will be stronger positive liquidity spillovers to national sovereign bond markets due to the hedging properties of SBBS (see Section 4.4.2). The liquidity of national sovereign bonds would therefore be improved to the extent that positive liquidity spillovers counteract the negative impact on market liquidity arising from the freezing effect. This implies that policymakers would have scope to expand the maximum SBBS market size beyond €2.6 trillion depending on the relative strength of these two effects on national sovereign bond market liquidity.

[46] Note that in practice total deviation from the ECB capital key would not be a continuous function of SBBS market size, as portfolio weights would be revised only at low frequency to minimise heterogeneity across SBBS series. To achieve this, portfolio weights would be defined ex ante based on the expected long-run size of the SBBS market. For example, if long-run market size were expected to be €1.5 trillion, portfolio weights would be set according to Table 2.1 of Volume I. In this case, total deviation from the ECB capital key would amount to 2.74 p.p. also in the transition to €1.5 trillion (and not only in the steady-state of €1.5 trillion).

Figure 4.6

Total underweighting relative to the ECB capital key with 33% and 50% issuer limits

(vertical axis is in percentage points; horizontal axis is in € trillions)



Source: ECB and ESRB calculations.
Note: The figure shows total deviation from the ECB capital key (in percentage points) for a given SBBS market size (in € trillions) subject to issuer limits of 33% or 50%. By comparison, total underweighting in the Eurosystem's holdings of sovereign bonds under its PSPP amounts to 5.77 p.p. (as at December 2017). The indicative SBBS portfolio weights shown in Table 2.1 in Volume I, which are based on a long-run SBBS market size of €1.5 trillion and an issuer limit of 33%, imply total deviation from the ECB capital key of 2.74 p.p. This corresponds to the intersection of the solid black line in the figure with a vertical line that crosses the horizontal axis at €1.5 trillion.

4.4 Impact on sovereign bond markets

The issuance of SBBS implies that some fraction of outstanding central government debt securities would be "frozen" on SBBS issuers' balance sheets, making them unavailable for trading. This gives rise to legitimate concerns about the impact of SBBS on the secondary market free float of sovereign bonds. In principle, SBBS issuers could lend out the securities, but this might violate the presumption that issuers would be mere pass-through entities. Therefore, for the purposes of this section, it is reasonable to assume that the sovereign bonds would indeed be "frozen" on the balance sheet of SBBS issuers.

On the other hand, SBBS would represent new securities with liquidity of their own. In principle, SBBS high liquidity and collateral eligibility and could be used to hedge price movements in sovereign bond markets. With a mature SBBS market, such properties could have positive spillover effects on liquidity in national sovereign debt markets. SBBS may also help to relieve the scarcity of low-risk assets. Some market participants perceive a shortage of such low-risk assets in

financial markets, particularly in the euro area. German sovereign bonds in particular appear scarce relative to demand. However, the excess demand for German sovereign bonds may be smaller with a greater supply of low-risk assets (i.e. senior SBBS). Using SBBS in repo markets instead of sovereign bonds would aid smooth market functioning: for every 26 units of German bonds retained by SBBS issuers, there would be 70 units of senior SBBS.

With these different effects, the overall impact of SBBS on liquidity in national sovereign bond markets is prima facie ambiguous. To shed more light on the overall impact of SBBS on market liquidity, the rest of this section examines the freezing and spillover effects in turn.

4.4.1 Freezing effect of SBBS

This section examines the freezing effect of SBBS. To do so, it draws on recent experience with the implementation of the Eurosystem's PSPP. Initiated in 2015, the PSPP involves the ECB and euro area national central banks purchasing government debt securities and other eligible public sector securities. Purchased securities are effectively "frozen" on the consolidated balance sheet of the Eurosystem (except for their limited availability for use in securities financing transactions under the conditions of the securities lending facility). Likewise, under SBBS, government debt securities would be frozen on the balance sheets of SBBS issuers (in the absence of any securities lending facility for SBBS). The Eurosystem's PSPP can therefore be used as a case study to gauge the likely effect of SBBS on national sovereign bond market liquidity. This represents a significant stress test of the likely impact of SBBS, since aggregate holdings of national debt instruments under the PSPP amount to €1.7 trillion (as at end-2017), which is at the upper range of the likely size of the SBBS market. Nevertheless, limitations to the analogy may give cause to expect that the liquidity impact would be somewhat different in the case of SBBS. These limitations to analogical reasoning are discussed at the end of this section.

Sovereign debt market liquidity can be measured by price-based and volume-based indicators. This section reports time variation in four liquidity indicators, two of which are price-based and two volume-based. In principle, the time variation in these indicators provides indicative evidence about the impact of PSPP on sovereign debt market liquidity.

First, bid-ask spreads are obtained from MTS at daily frequency from January 2014 to December 2017. MTS provides electronic trading platforms in government bond markets, focusing on euro-denominated securities. MTS is one of the largest interdealer platform providers in the euro area, with about €100 billion of average daily turnover. This turnover is based on a non-representative sample of government bonds, however. Daily turnover of German government bonds on MTS, for example, represents only about €5 billion out of a total of €350 billion, so insights into certain market segments might have limited external validity.

In the MTS dataset, bid-ask spreads are measured in basis points as the difference between the best bid and ask prices posted on the domestic and European MTS platforms, normalised by the mid-price and averaged over each trading day. Bid and ask prices are posted with respect to benchmark 10-year national sovereign bonds. Figure 4.7 (Panel A) plots these normalised bid-ask spreads over time. Visually, there is no apparent general level shift in these bid-ask spreads following the commencement of PSPP purchases in March 2015, which is denoted by the vertical black line in the figure.

To shed more light on the relationship between bid-ask spreads and the PSPP, Figure 4.7 (Panel B) plots spreads against the fraction of outstanding central government debt securities held by the Eurosystem under its PSPP. The purpose of this analysis is to examine whether increases in PSPP holdings are associated with increases in normalised bid-ask spreads. Overall, there is no systematic evidence of bid-ask spreads increasing as the fraction of PSPP holdings increases. However, normalised bid-ask spreads appear to increase in German and Austrian government debt securities towards the latter part of the sample period, which is consistent with the findings of Schlepper et al (2017) regarding scarcity in German government bonds. However, this insight should be interpreted with due caution owing to the relatively low turnover of German government bonds on MTS platforms.

Second, Figure 4.8 plots a proprietary liquidity index computed by Tradeweb. Tradeweb is a request-for-quote trading platform focused on the dealer-to-customer market segment. Tradeweb's index is plotted against time (Panel A) and the fraction of outstanding central government debt securities held by the Eurosystem under its PSPP (Panel B). Calculated using granular trading data, the index is intended to measure liquidity levels within specific fixed income markets based on transaction prices relative to the mid-price. It is therefore comparable to MTS bid-ask spreads in that both indicators are price-based, with the difference that MTS data are based on quotes and Tradeweb data on transaction prices from actual trades. Tradeweb's index is more volatile because it is based on trade sizes that more variable and typically smaller than those on MTS, as they reflect customer trades with a smaller number of dealers. By contrast, the MTS platform is a transparent limit order market which is very competitive. However, there is no systematic upward trend in Tradeweb's liquidity index across countries, despite the higher volatility in the Tradeweb index. There nevertheless appears to be a slight worsening in the liquidity index for some countries in 2017, perhaps owing to the continued increase in PSPP holdings.

The next liquidity variable, also computed by Tradeweb, is based on volumes rather than prices (Figure 4.9). This categorical variable is plotted against time (Panel A) and the fraction of outstanding central government debt securities held by the Eurosystem under its PSPP (Panel B). The variable is calculated based on the ratio of a day's notional traded volume over the average daily notional traded volume of the preceding 90 days. This ratio is then mapped to one of five categories, which can take the value of any integer between one and five inclusive, where one corresponds to low turnover and five to high turnover.[47] Across countries, the average value of this indicator is 2.8 in the sample period, with no change following the introduction of the PSPP,

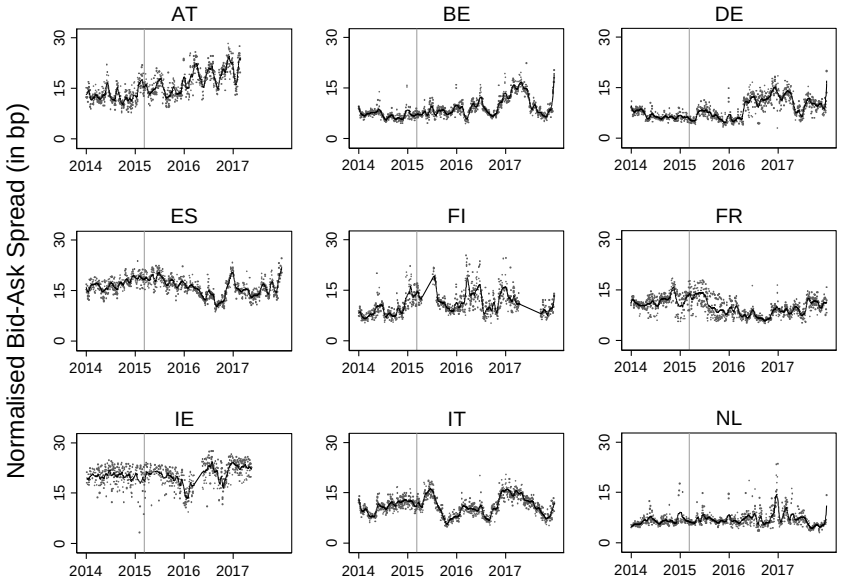
Continuing along the lines of volume based measures, Figure 4.10 plots the Hasbrouck ratio. Similar to Amihud (2002), the Hasbrouck ratio is calculated as square root of the logarithmic daily price difference over total turnover. Panel A plots the Hasbrouck ratio over time, and Panel B plots it against the fraction of outstanding central government debt securities held by the Eurosystem under its PSPP. This indicator is in line with the findings from other indicators: there is no observable worsening of liquidity over the duration of the Eurosystem's PSPP.

[47] In particular, a value of one corresponds to a ratio of less than or equal to 0.8, i.e. a "very low" turnover on that day relative to the preceding 90 days; a value of two corresponds to a ratio between 0.8 and 0.9, i.e. a "below average" turnover; a value of three corresponds to a ratio between 0.9 and 1.1, i.e. "average" turnover; a value of four corresponds to a ratio between 1.1 and 1.2, i.e. "above average" turnover; and a value of five corresponds to a ratio of more than 1.2, i.e. "very high" turnover.

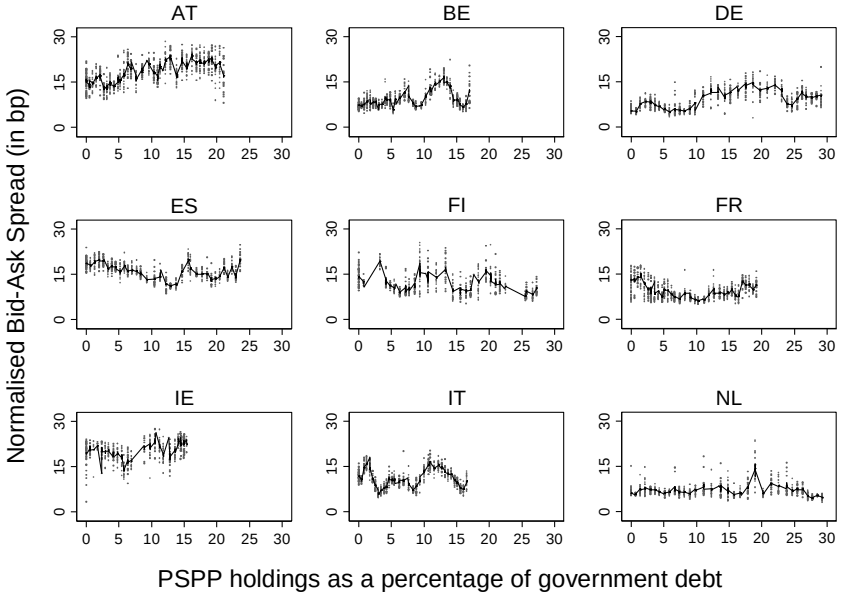
Figure 4.7

Normalised bid-ask spreads

Panel A: Normalised bid-ask spreads over time



Panel B: Normalised bid-ask spreads against the fraction of government debt securities held by the Eurosystem under its PSPP



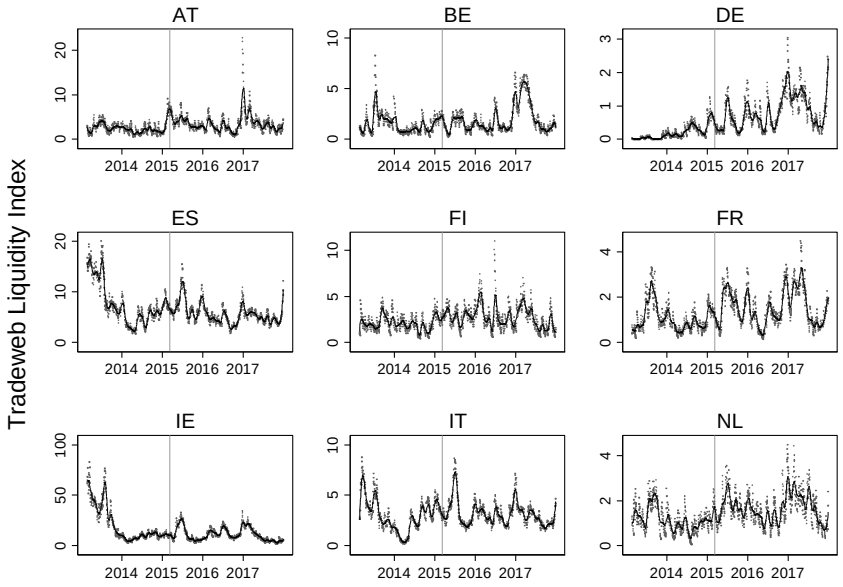
Source: MTS and ESRB calculations.

Note: The figure plots the time series of bid-ask spreads over time (Panel A) and against the fraction of outstanding government debt securities held by the Eurosystem under its PSPP (Panel B). Bid-ask spreads are measured in basis points as the difference between the best bid and ask prices posted on the domestic and European MTS platforms for benchmark 10-year national sovereign bonds, normalised by the mid-price, and averaged over each trading day. The vertical lines in Panel A refer to 9 March 2015, when the Eurosystem's PSPP began.

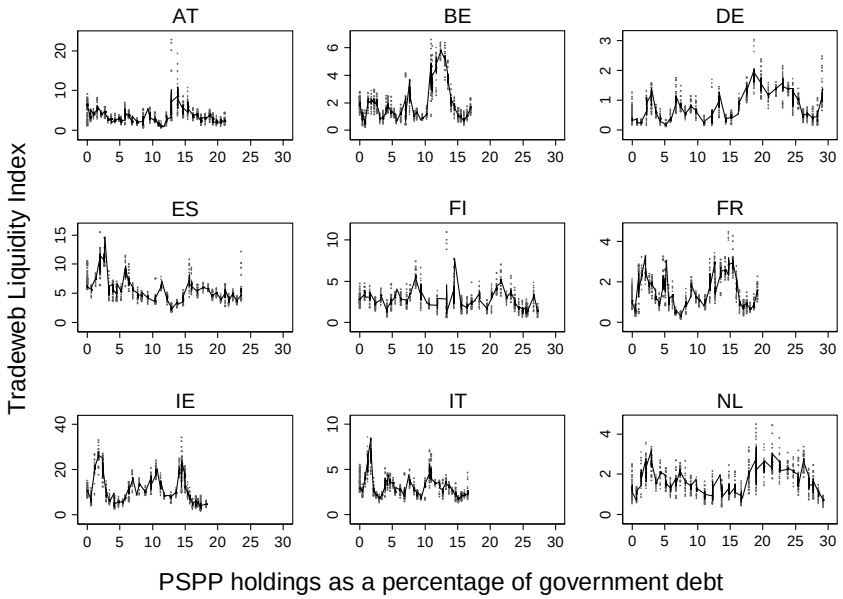
Figure 4.8

Tradeweb liquidity index

Panel A: Tradeweb liquidity index over time



Panel B: Tradeweb liquidity index against the fraction of government debt securities held by the Eurosystem under its PSPP



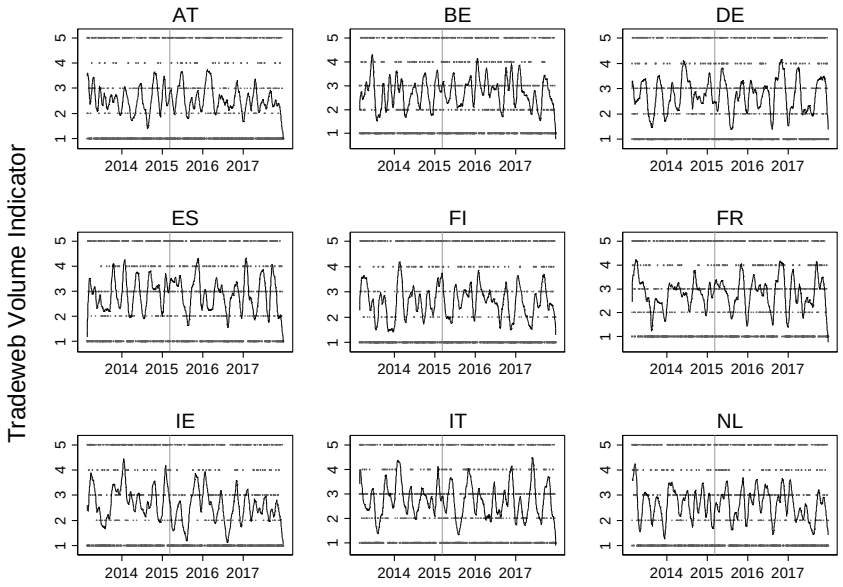
Source: Tradeweb and ESRB calculations.

Note: The figure plots the Tradeweb liquidity index over time (Panel A) and against the fraction of outstanding government debt securities held by the Eurosystem under its PSPP (Panel B). The index measures liquidity levels in fixed income markets based on transaction spreads relative to the mid-price. The vertical lines in Panel A refer to 9 March 2015, when the Eurosystem's PSPP began.

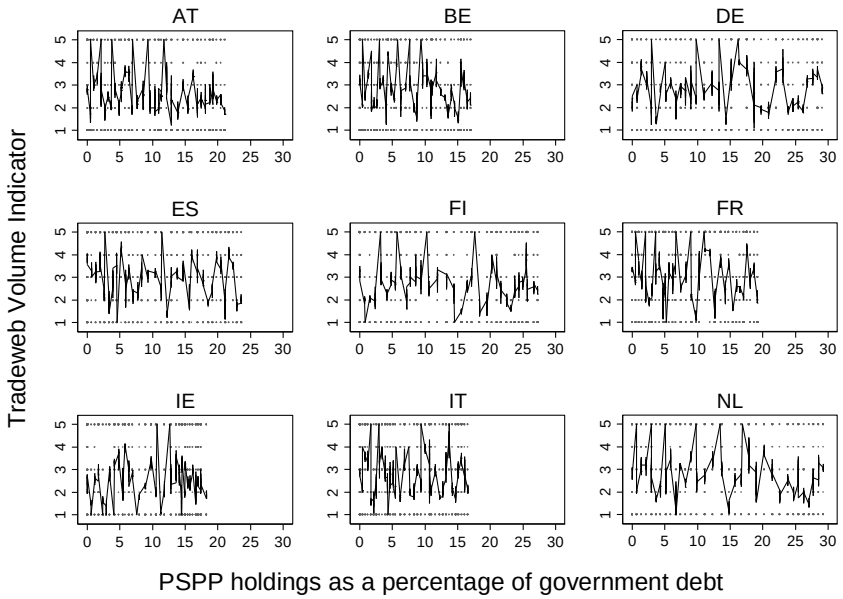
Figure 4.9

Tradeweb volume indicator

Panel A: Tradeweb volume indicator over time



Panel B: Tradeweb volume indicator against the fraction of government debt securities held by the Eurosystem under its PSPP



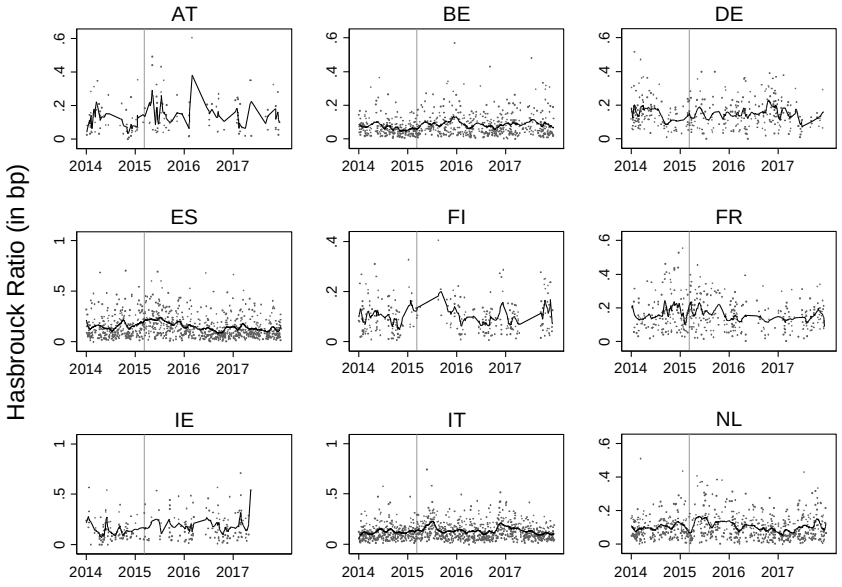
Source: Tradeweb and ESRB calculations.

Note: The figure plots the time series of the Tradeweb volume indicator over time (Panel A) and against the fraction of outstanding government debt securities held by the Eurosystem under its PSPP (Panel B).. The indicator is a categorical variable ranging from one to five, where one indicates "very low" trading volume in that day and 5 indicates "very high" volume. The vertical lines in Panel A refer to 9 March 2015, when the Eurosystem's PSPP began.

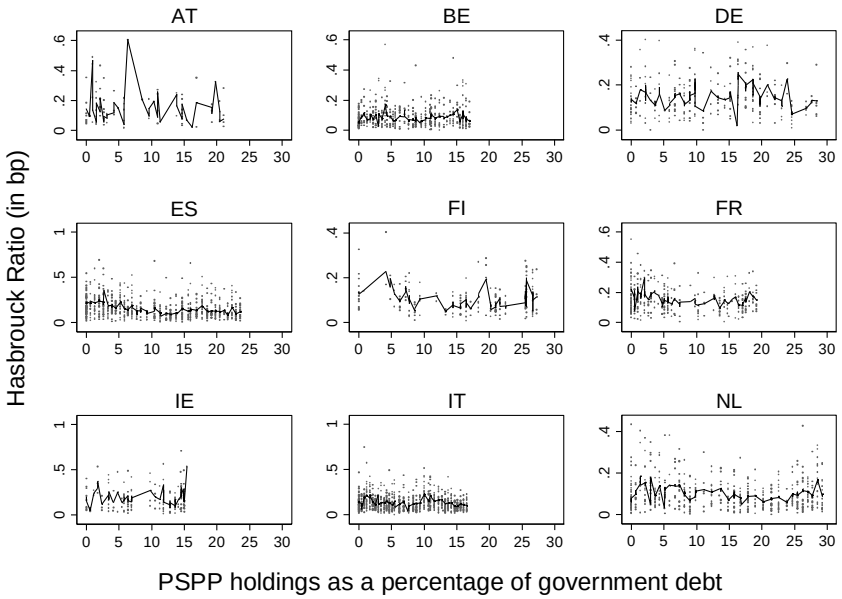
Figure 4.10

Hasbrouck ratio

Panel A: Hasbrouck ratio over time



Panel B: Hasbrouck ratio against the fraction of government debt securities held by the Eurosystem under its PSPP



Source: MTS and ESRB calculations.

Note: The figure plots the Hasbrouck ratio over time (Panel A) and against the fraction of outstanding government debt securities held by the Eurosystem under its PSPP (Panel B).The Hasbrouck ratio is the square root of the logarithmic daily price difference over total turnover. The vertical lines in Panel A refer to 9 March 2015, when the Eurosystem's PSPP began.

The remainder of this section makes use of a regression analysis to provide a more rigorous assessment of the impact of the PSPP on sovereign bond market liquidity. In particular, this section reports results of regressions of normalised bid-ask spreads on the share of outstanding central government debt securities held by the Eurosystem under its PSPP, as well as time and country fixed effects. Fixed effects are included in the regression in order to control for two sources of variation in bond liquidity. First, variation that arises from aggregate shocks to liquidity caused by institutional changes or from aggregate variation in risk tolerance. Second, country-level heterogeneity in market liquidity, such as differences in the depth of the national public debt markets, competition between market-makers, and country-level variation in sovereign risk.

The relationship between cumulative bond purchases and normalised bid-ask spreads is not linear. The model that best describes the data is cubic. This means that normalised bid-ask spreads are regressed on the first, second and third powers of the share of central government debt securities held by the Eurosystem under its PSPP, as well as time and country fixed effects. The results of this panel regression are reported in Table 4.9. They indicate that, controlling for (unreported) time and country fixed effects, the effect of PSPP holdings on normalised bid-ask spreads is statistically significant, with larger holdings conditionally associated with higher spreads.

Table 4.9

Results of a fixed effects panel regression of bid-ask spreads on PSPP holdings

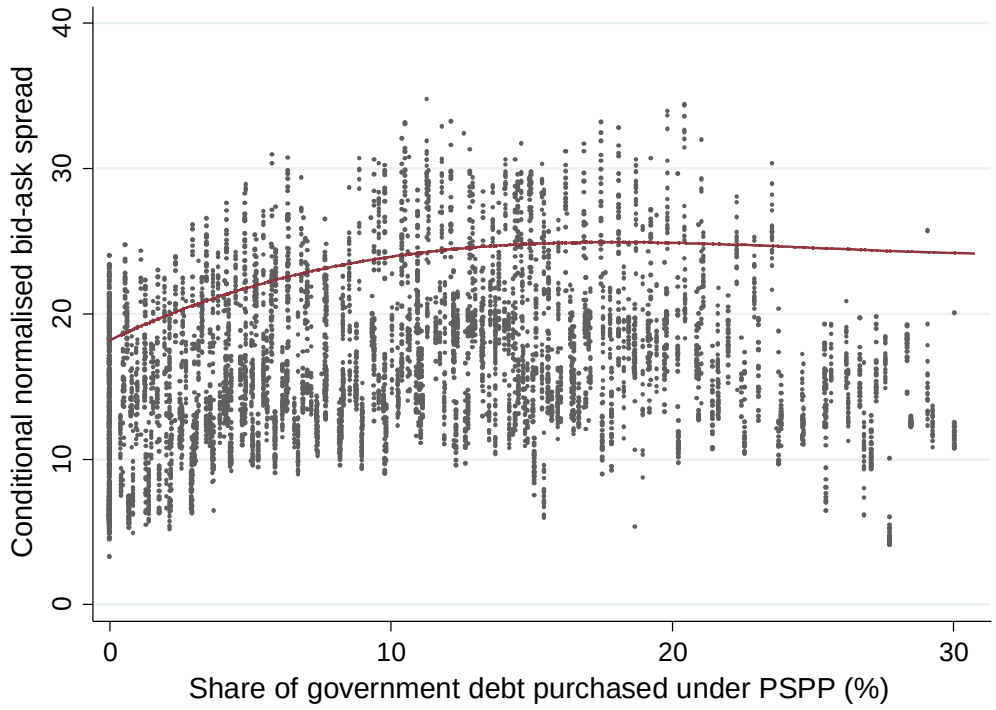
	Coefficient	Standard error	P-value
Share of government debt held under the Eurosystem's PSPP	0.9203	0.1735	0.0000
Squared term	-0.3974	0.0092	0.0000
Cubed term	0.0005	0.0017	0.0020
Constant	18.1831	0.2448	0.0000

Note: The table reports the results of a panel regression of normalised bid-ask spreads on the first three powers of the share of government debt held by the Eurosystem under its PSPP as well as country and time fixed effects (the estimated coefficients of which are not reported). The "squared term" and "cubed term" are the squared and cubic powers of the share of government debt held by the Eurosystem under its PSPP. As at December 2017, the mean share across euro area countries was 22%, which the regression predicts is associated with an increase in bid-ask spreads by four basis points relative to a 0% share.

To shed light on the economic significance of this result, Figure 4.11 plots predicted bid-ask spreads at different levels of PSPP purchases. Specifically, the red line plots the predicted normalised bid-ask spreads on euro area sovereign bonds for different levels of cumulative PSPP purchases. The dots depict observations on the normalised bid-ask spread for each country after controlling for the country and time fixed effects estimated in the panel regression. The figure suggests that the economic significance of the relationship between PSPP holdings and bid-ask spreads is minor. The mean share of central government bonds held by the Eurosystem under its PSPP (as at December 2017) was 22%. At that value, the predicted normalised bid-ask spread increases by four basis points relative to the status quo ante in which the PSPP did not exist. Beyond that, the regression model does not predict any significant further deterioration in measured liquidity as programme purchases increase. PSPP holdings of 29% (as a fraction of outstanding central government debt securities), for example, are not associated with any further increase in spreads relative to the 22% case. This conclusion is in line with findings elsewhere in this section, which identifies little evidence of a meaningful negative effect on sovereign bond market liquidity owing to the Eurosystem's PSPP.

Figure 4.11

Conditional and fitted values of normalised bid-ask spreads as a function of PSPP holdings



Source: MTS and ESRB calculations.
Note: The figure plots the normalised bid-ask spread for each country after controlling for the country and time fixed effects estimated in the panel regression. The fitted values in the red line are predicted euro area aggregate normalised bid-ask spreads, calculated from the estimated coefficients reported in Table 4.9.

Overall, these findings are broadly consistent with those in the academic literature.

Schneider, Lillo and Pelizzon (2016) analyse sovereign bond market liquidity in 2015 (in the months immediately following the commencement of the PSPP). They find that five and 10-year Italian sovereign bonds remained liquid and stable over 2015, consistent with Figure 4.7. However, they also find that 30-year Italian sovereign bonds turned illiquid over the same period, which is consistent with the view that the PSPP may have had a larger impact on liquidity levels in already less liquid segments of the market. Similarly, using a high-frequency, transaction-level analysis of Bundesbank purchases of German sovereign bonds in the context of the PSPP, Schlepper, Hofer, Riordan and Schrimpf (2017) find that the price impact of purchases was strong when markets were less liquid. However, the exception to this generally benign finding is Germany, where PSPP purchases appear to have induced a temporary deterioration in market liquidity over short periods. In their analysis of PSPP purchases of German government bonds, Schlepper et al (2017) find that bid-ask spreads widened for purchased securities, particularly when compared to non-eligible bonds, while market depth was reduced for purchased securities compared to non-purchased eligible bonds (with a magnitude of up to €1.6 million per €100 million purchased).

The PSPP analogy implies that an SBBS programme of similar size might have a comparable freezing effect on national sovereign debt markets. However, there are two key differences between SBBS and the PSPP which limit the inference that may be drawn from analogical reasoning. First, the analogy assumes that an SBBS programme would reach maturity in a steady state in which non-standard monetary policy measures, including the PSPP, will have been unwound. Otherwise, a large SBBS market would interact with large PSPP holdings, which could generate a detrimental effect on market liquidity since both programmes would have a freezing effect on national sovereign debt markets. Second, although the analogy between SBBS and the PSPP delivers useful insights, it is imperfect insofar as SBBS and PSPP entail meaningful differences. In particular:

- **Securities lending:** The Eurosystem implements a securities lending facility as part of its PSPP. This facility makes securities purchased under the PSPP available for short-term lending (subject to certain conditions). In exchange, counterparties post different securities (or, since December 2016, cash) as collateral, for a fee based on market repo rates. The ECB and the national central banks of the Eurosystem determine the securities lending modalities of their respective PSPP holdings, including collateral eligibility, pricing, haircut, term and counterparty eligibility, allowing them to adjust the parameters of the facility to reflect domestic infrastructures and market practices. The overall purpose of the facility is to support secondary market liquidity by alleviating bond scarcity. However, a €50 billion limit is placed on the cash collateral scheme to maintain the overall accommodative monetary policy stance. As at December 2017, about 3.5% of total PSPP holdings were lent against collateral via the securities lending facility. From the perspective of SBBS, a comparable securities lending facility would require active securities management by SBBS issuers, which are intended to be pass-through entities. Nevertheless, if collateral scarcity were considered severe, such a facility could in principle be integrated into an SBBS programme, allowing SBBS issuers to make their holdings of government debt securities available for lending against low-risk securities or cash. A desirable feature of such a securities lending facility would be that the securities of different jurisdictions could be accessed with similar conditions. As an additional benefit, such a facility could provide an ancillary source of income for SBBS issuers, the proceeds from which could be used to inject additional credit enhancement into the structure. If a securities lending facility were to be implemented for SBBS, it would need to be subject to adequate risk management, including minimum collateral haircuts and quantitative limits, to protect issuers against market volatility.

- **Maturity points:** Securities eligible for purchases under the PSPP must have a residual maturity of between one and 30 years. Within this constraint, the PSPP is implemented in a market neutral manner. At the end of 2017, the weighted average maturity of debt securities held by the Eurosystem under its PSPP was 7.7 years, which broadly mirrors that of outstanding debt securities.[48] However, it may be preferable to focus on certain points of the curve – notably five- and 10-year debt securities – in the early phase of SBBS market development in order to build liquid benchmarks that would aid price discovery and facilitate

[48] According to the OECD sovereign borrowing outlook (2016), the weighted average terms to maturity of outstanding central government debt securities were as follows in 2015: Austria (8.5 years), Belgium (8), Finland (6), France (7), Germany (6.5), Ireland (13), Italy (6.5), Luxembourg (7), the Netherlands (8), Portugal (8) and Spain (8).

the development of a futures market. SBBS might therefore have a disproportionately large impact on liquidity at these specific maturity points. In equilibrium, however, DMOs could offset such scarcity effects by issuing more bonds at these maturities. Moreover, maturity selection in an SBBS issuance programme could be continually fine-tuned, just as the parameters of the PSPP have been revised following market developments. In steady state, an SBBS market could be neutral with respect to maturity in order to build a full and liquid curve. Also, unlike the PSPP, securities in the SBBS cover pool could feasibly have a residual maturity of less than one year or more than 30 years on the date of purchase by SBBS issuers, so that SBBS could eventually be even more market neutral than the PSPP.

- **Venue of purchases:** Purchases under the PSPP take place exclusively in secondary markets to avoid the monetary financing of governments that could be implied by primary market intervention. With SBBS, however, no such constraint would apply, since SBBS issuers are pass-through entities rather than final investors. Consequently, SBBS issuers could circumvent the short-run price volatility that might otherwise occur following large-scale purchases in thin secondary markets. However, purchases on primary markets may also have an impact on market prices, depending on their market design. This might provide additional motivation for experimenting with private placements to SBBS arranger(s).

- **Timing of purchases:** Purchases under the PSPP are made in a continuous manner to avoid excessive market disruption. However, purchases of sovereign bonds to assemble the SBBS cover pool would most likely take place in lumpy batches, corresponding to discrete SBBS issuance dates.

- **Development of a new market:** An SBBS programme would differ from the PSPP as the former constitutes a partial replacement of long-term bonds with different long-term bonds, whereas the PSPP essentially replaces long-term bonds with money. This implies that SBBS could be a source of liquidity and hedging opportunities that would help dealers to provide market liquidity elsewhere. For example, the three securities could be combined to price sovereign bonds. This would require the SBBS market to become large enough to facilitate a reversal in the direction of the price discovery mechanism, as the next section explains.

4.4.2 Positive spillover effect of SBBS

Another important difference between PSPP and SBBS concerns the duration of the instruments created under each programme. The PSPP provides liquidity to financial markets by swapping medium- and long-term debt securities for central bank reserves. By contrast, an SBBS programme would effectively swap national sovereign bonds for securities of identical duration. This is an important difference, since it implies that SBBS, in contrast to the PSPP, would be market neutral with respect to duration. The relative neutrality of SBBS has implications for the spillover effects on market liquidity with SBBS (as compared with the PSPP). In particular, positive spillover effects may arise from SBBS owing to their provision of collateral services and hedging opportunities, conditional on SBBS attaining adequate liquidity and there being a level playing field in terms of the regulatory treatment of SBBS.

First, SBBS could mitigate collateral scarcity insofar as they provide collateral services. Repo markets in sovereign bonds are well-developed, so SBBS would presumably be an imperfect

substitute for sovereign bonds in the early phases of SBBS market development. A mature SBBS market, however, could be associated with an active repo market using SBBS, once the necessary infrastructure has developed (see Section 4.2.2).

Second, SBBS could provide hedging opportunities. If SBBS are adequately liquid, dealer-banks could use an optimally weighted SBBS portfolio to hedge short or long positions in sovereign bonds acquired while making markets. If hedging removes the systematic risks responsible for dealers' inventory holding costs, then well-diversified dealers could provide liquidity at bid and ask quotes that are sufficient to cover hedging costs. Liquid SBBS would then imply additional liquidity benefits for the underlying sovereign bond markets. The analysis summarised below, and elaborated in more detail by Dunne (2018), suggests that the liquidity of euro area sovereign bond markets would likely benefit from the existence of a liquid SBBS market.[49]

Intermediary arbitrage and diversification

The benefit of hedging with a highly liquid, contemporaneously correlated asset is easy to see in the extreme case of perfect correlation. Let ask and bid prices in the individual sovereign bond market be denoted (a) and (b) and those in the SBBS market be (A) and (B) respectively. Assuming no frictions (i.e., no basis, coordination, execution or timing risks and no variability in market-making risks or risk aversion), then arbitrage and competition between dealers should keep the two bid-ask spreads close to each other. Perfect correlation in the underlying values of the two securities, and under the assumption of instantaneous availability of trading opportunities in the highly liquid asset, makes it possible to subtract the common underlying value changes, V(t), from all bid and ask prices in each period t, leaving a*, A*, b* and B* as timeless (where starred variables are deviations from the relevant common V(t)).[50]

A dealer who acquires a long position (say of one unit of the bond) at price (b) can immediately sell an equal amount in the SBBS market at price (B). This leaves the position hedged against movements in V until the bond is sold again at price (a) and the SBBS is simultaneously bought at (A). Regardless of common movements in V, there is a profit for the dealer of B*-b* + a*-A*. This profit is trivially increasing in the difference between the sovereign and SBBS bid-ask spreads, (s-S). In a competitive market, such differences in spreads should be competed away (excluding any extra costs associated with operating in the more general environment). The spread in the bond market will, in this case, be primarily determined by the required bid-ask spread in the SBBS market.

Under certain circumstances, it remains worthwhile to hedge even when there is only a partial correlation in the true values of the hedge instrument and asset being hedged. Since

[49] The literature from which this analysis and the empirical strategy derive their inspiration includes Amihud and Mendelson (1980), Baranova et al (2016), Bessler et al (2016), Chen et al (2003), Copeland and Galai (1983), Demsetz (1968), Dunne et al (2007), Easley and O'Hara (1987), Froot and Stein (1998), Gao et al (2017), Glosten and Milgrom (1985), Hagströmer et al (2016), Ho and Stoll (1981, 1983), Huang and Stoll (1997), Koutmos and Pericli (2000), Lucas et al (2017), Marcus and Ors (1996), Morgan (2008), Naik and Yadav (2003), Stoll (1978), Tinic and West (1972), Tran et al (2012) and Yuan (2005).

[50] If not, then the proposition applies on average across many trades.

the hedge in such cases would not fully protect the dealer from fluctuations in the value of the bond, the remaining risk must either be managed or passed-on. The principal conjecture, however, is that bid-ask spreads in the bond market would remain close to SBBS spreads so long as dealers are diversified in their trading activities. This is because hedging with factor-mimicking instruments such as SBBS would take away all of the systematic risk and leave only idiosyncratic risk. The idiosyncratic risk will shrink through the effects of diversification if a diversified portfolio of such positions is held. Since only the non-diversifiable component of the unhedged risk will require compensation, the link between the size of the spread in the hedge instrument and that in the asset being hedged is relatively unaffected relative to the case of a perfectly correlated hedge. If hedge instruments behave like risk factors for the entire market – as is the case with SBBS, which are backed by single-name sovereign bonds – then unhedged risks will be largely diversifiable. Hence, any unhedged risks will largely average out in trading portfolios if dealers are active in providing liquidity across all markets that contribute to the securitisation.[51]

Choosing hedge ratios and assessing hedge effectiveness

To validate the liquidity spillover conjecture, the effects of hedging using estimated SBBS yields is assessed by measuring the magnitude and stability of time-varying correlations between single SBBS (or portfolios) and individual sovereign bonds. Correlations are measured using a range of methodologies, including dynamic conditional correlation employing DCC-GJR-GARCH modelling. Diversification benefits are then measured by comparing the variance of a portfolio of hedged positions (with equal weights) with the variances in the component markets.

The principal means of assessing hedge effectiveness is by reference to the proportional reduction in variance of the hedged portfolio relative to the unhedged portfolio. Since hedging is inherently about controlling risk in the future, the question arises as to whether historic or forward-looking estimates of covariances and variances should be used to set hedge ratios in a real-time context. The hedge selection and assessment carried out in Dunne (2018) closely follows the comprehensive approach of Bessler et al (2016), which is the most similar work assessing time-varying conditional hedging in a European sovereign bond context. Bessler et al (2016) test both single and composite hedging strategies (involving German and Italian government bond futures). They employ one-day out-of-sample testing of hedge effectiveness, with hedge ratios selected based on a number of techniques including rolling OLS, constant conditional correlation (CCC), dynamic conditional correlation (DCC-GARCH) and a Bayesian-based mixture of models. Since many of these fitting methods are encompassed by the DCC-GARCH approach, only DCC-based results are summarised here. The results discussed were obtained with DCC-GJR-GARCH(1,1).

[51] It may also be supposed that this benign outcome would be compromised if the large-market asset (the hedge) has a difficult-to-forecast correlation with the small-market asset (i.e. if out of sample hedge ratios prove less efficient than they could have been). This is a type of operational risk and gives rise to mostly idiosyncratic and diversifiable risks (assuming forecasts are as efficient as possible ex ante).

Derivation of SBBS yields

This analysis relies on SBBS yield estimates based on a simulation approach proposed by Schönbucher (2003). It is important to state that the Schönbucher (2003) method retains the properties of the underlying relationship between yields, including changing correlations, and embeds them appropriately in the estimated SBBS yields. Hence, the estimated SBBS yields in this case are not just some linear combination of the underlying securities. If they were, it would determine the time varying correlations that are used for hedge selection. The Schönbucher approach retains the variable PDs in the underlying securities as well as their time-varying interdependencies.

Evidence for out-of-sample hedge effectiveness

The optimal SBBS hedge ratio(s) for each national sovereign using SBBS as the hedge instrument(s) are estimated, comparing risks when hedged and unhedged. In line with previous literature, the hedge estimates for a particular date are based on applying the chosen hedge selection method (e.g. linear regression) for a prior 250-day window and rolling the estimation window forward at regular intervals (roughly at monthly intervals). The estimated hedge ratio is used in the out-of-sample interval until the next hedge ratio is estimated.

Hedge effectiveness for each hedge is assessed by comparing (taking the ratio of) the hedged and unhedged standard deviation of returns and VaRs (where, in the case of VaR, the average of the ratio of the 5% and 95% VaRs is used). These ratios are shown for each of three sub-samples in Tables 4.11 to 4.13. In general, the tables show that hedging is effective in the in reducing the variance of returns, particularly in the pre-crisis period. Hedging is less effective for high-risk sovereign bonds during the height of the sovereign debt crisis, but effectiveness returns to some extent during the recovery. In general, the combined hedge works better than the single hedge in the crisis and recovery periods.

The results for the pre-crisis period are shown in Table 4.10. In this period, hedge effectiveness is high for all countries. In the case of a single hedge, senior SBBS generally provide the best protection. The hedged/unhedged risk ratio for the best single hedges – based on standard deviation of daily returns – ranges from 0.21 for Germany to 0.64 for Greece. In almost all cases, the 2-SBBS hedge provides some marginal improvement in hedge effectiveness over the single hedge case (with all ratios below 0.50). In many cases, the 3-SBBS hedge is best overall.

Table 4.11 shows summary statistics for hedged/unhedged relative risks during the sovereign debt crisis. For the 1-SBBS hedge only Germany remains well hedged using senior SBBS (0.32). Roughly half of the risk is avoided by single-SBBS hedging for the case of Finland and the Netherlands, while bonds issued by the remaining sovereigns are not amenable to single-SBBS hedging in this crisis period. Moving to 2-SBBS or 3-SBBS hedging generally gives rise to some small, but significant, risk reduction for most sovereign bond holdings relative to the single-SBBS case. Table 4.12 covers the recovery period (from July 2012 up to the final quarter of 2016). It is usually possible to reduce risks by half or more by using composite hedging.

Cross-country diversification of risks

Once risks have been hedged, there is potential for dealers to diversify remaining risks by operating simultaneously across many sovereign bond markets. It is likely that a dealer will have a portfolio of outstanding positions in many markets. The individual net hedged positions are likely to be much smaller than unhedged positions (e.g. if the hedge ratio is close to one, the individual net hedged positions will be minor). Even these small individual net positions could be subject to more offsetting across the different sovereign bond markets (if some are net-long and others are net-short). Since these offsetting situations are not subject to common movements, however, there should be no further reduction in risk from such netting.

The upper panels of Figure 4.12 compare returns on a cross-country portfolio of hedged and unhedged positions for the pre-crisis period. The portfolio of hedged positions has a much smaller dispersion. (This assumes that the same capital position is involved: if hedging reduces the capital position, then the risk in the hedged portfolio would be even smaller.) Despite the same capital exposure, diversification reduces risks more for the hedged positions than unhedged; this is due to the fact that there are mostly idiosyncratic risks surviving in the hedged case, while the unhedged case involves some systematic risk which cannot be reduced by diversification.

The lower panels of Figure 4.12 concern the more volatile conditions of the sovereign debt crisis and the recovery period. In this case, there is not much benefit from hedging because most risk is idiosyncratic. This means that diversification is equally effective in the case of the unhedged portfolio. In general, the risks are much lower than risks for typical single-name sovereign bonds during this period. It is still the case that hedging starts to matter again during the recovery. And it is also the case that hedging will probably involve less committed capital during this time as normal hedges were unavailable.

Conclusion

The analysis in this section suggests that the presence of SBBS gives rise to an environment in which hedging individual sovereign positions and diversifying dealer activities across countries produce large reductions in dealer risks. This proposition is tested using estimated SBBS yields. The findings appear robust to the assumption of a similar capital exposure under hedging, as there is still a marked reduction in risks. The smaller markets are generally more idiosyncratic in their movements and the associated risks are easy to diversify. Overall, assuming regulation does not penalise netting excessively, then there is a prospect of a significant reduction in trading costs across euro area sovereign debt markets if SBBS were to become benchmark securities.

Table 4.10

Hedge effectiveness pre-crisis

Hedge	Snr	Mezz	Jnr	Snr-Mezz	Snr-Jnr	Mezz-Jnr	Snr-Mezz-Jnr
AT(i)	0.38	0.39	0.65	0.33	0.3	0.5	0.28
AT(ii)	0.27	0.28	0.65	0.23	0.18	0.43	0.16
BE(i)	0.35	0.37	0.64	0.28	0.25	0.48	0.23
BE(ii)	0.29	0.3	0.63	0.24	0.2	0.42	0.17
DE(i)	0.21	0.22	0.68	0.16	0.16	0.54	0.13
DE(ii)	0.15	0.19	0.69	0.14	0.12	0.51	0.11
ES(i)	0.45	0.45	0.64	0.38	0.34	0.47	0.31
ES(ii)	0.38	0.39	0.64	0.31	0.27	0.42	0.25
FI(i)	0.3	0.31	0.65	0.28	0.25	0.54	0.24
FI(ii)	0.21	0.23	0.64	0.19	0.16	0.47	0.16
FR(i)	0.28	0.29	0.63	0.22	0.2	0.47	0.17
FR(ii)	0.24	0.25	0.63	0.19	0.16	0.41	0.12
GR(i)	0.64	0.67	0.73	0.54	0.49	0.51	0.45
GR(ii)	0.54	0.56	0.67	0.4	0.4	0.42	0.33
IE(i)	0.58	0.6	0.74	0.53	0.49	0.61	0.48
IE(ii)	0.34	0.38	0.67	0.3	0.28	0.48	0.28
IT(i)	0.5	0.53	0.65	0.37	0.35	0.41	0.28
IT(ii)	0.44	0.5	0.63	0.31	0.3	0.36	0.23
NL(i)	0.31	0.32	0.63	0.25	0.22	0.46	0.19
NL(ii)	0.23	0.25	0.64	0.2	0.17	0.42	0.14
PT(i)	0.5	0.52	0.66	0.41	0.37	0.46	0.33
PT(ii)	0.38	0.4	0.62	0.31	0.27	0.39	0.23

Source: Dunne (2018) and ESRB calculations.
Note: The table quantifies the effectiveness of SBBS in hedging price movements in single-name sovereign bonds. Rows labelled (i) contain the ratio of the standard deviation of hedged returns relative to unhedged returns. Rows labelled (ii) contain the average of the ratio of the 95th and 5th quantiles of the distributions of hedged returns relative to unhedged returns. In each case, the best hedge is shown in blue.

Table 4.11

Hedge effectiveness during the sovereign debt crisis

Hedge	Snr	Mezz	Jnr	Snr-Mezz	Snr-Jnr	Mezz-Jnr	Snr-Mezz-Jnr
AT(i)	0.76	0.89	1	0.68	0.84	1.04	0.74
AT(ii)	0.68	0.81	0.98	0.59	0.61	0.95	0.59
BE(i)	0.97	0.96	0.98	0.73	1.1	0.84	0.8
BE(ii)	0.98	0.98	1	0.73	0.9	0.83	0.71
DE(i)	0.32	1	1.07	0.28	0.33	1.04	0.29
DE(ii)	0.31	1.04	1.05	0.27	0.31	0.95	0.27
ES(i)	1.01	1.1	1.01	0.67	1.1	0.69	0.72
ES(ii)	0.97	1.15	1.05	0.71	0.87	0.66	0.65
FI(i)	0.48	0.93	1.03	0.48	0.51	1.06	0.53
FI(ii)	0.46	0.96	1.02	0.46	0.46	1.04	0.45
FR(i)	0.77	0.88	1	0.65	0.85	1	0.69
FR(ii)	0.7	0.88	1.02	0.62	0.68	1.02	0.62
GR(i)	1	1.01	1	1	0.85	0.85	0.83
GR(ii)	0.96	1.13	1.11	1.02	1.26	1.28	1.23
IE(i)	1.02	1.07	1.02	0.97	1.01	0.98	1.01
IE(ii)	0.99	1.06	1.03	0.95	0.92	0.93	0.94
IT(i)	1	1.1	1.01	0.56	1.18	0.61	0.63
IT(ii)	1.02	1.13	1.03	0.6	0.91	0.57	0.56
NL(i)	0.51	0.91	1.02	0.52	0.54	1.07	0.57
NL(ii)	0.47	0.94	1.05	0.48	0.48	1.03	0.49
PT(i)	1.01	1.05	1.01	0.99	1.01	0.98	1
PT(ii)	1.01	1.02	1.01	0.95	0.9	0.92	0.91

Source: Dunne (2018) and ESRB calculations.
Note: The table quantifies the effectiveness of SBBS in hedging price movements in single-name sovereign bonds. Rows labelled (i) contain the ratio of the standard deviation of hedged returns relative to unhedged returns. Rows labelled (ii) contain the average of the ratio of the 95th and 5th quantiles of the distributions of hedged returns relative to unhedged returns. In each case, the best single hedge is shown in blue.

Table 4.12

Hedge effectiveness post-crisis

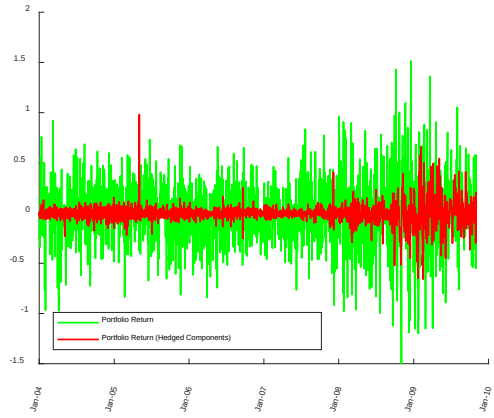
Hedge	Snr	Mezz	Jnr	Snr-Mezz	Snr-Jnr	Mezz-Jnr	Snr-Mezz-Jnr
AT(i)	0.55	0.78	1	0.53	0.51	0.9	0.51
AT(ii)	0.49	0.75	1	0.47	0.43	0.86	0.44
BE(i)	0.56	0.74	0.98	0.52	0.47	0.87	0.48
BE(ii)	0.5	0.72	0.97	0.47	0.43	0.85	0.43
DE(i)	0.27	0.87	1.04	0.26	0.27	0.92	0.25
DE(ii)	0.28	0.9	1.04	0.27	0.27	0.93	0.26
ES(i)	0.98	1.02	0.97	0.68	0.74	0.58	0.57
ES(ii)	0.96	0.94	0.96	0.71	0.72	0.59	0.57
FI(i)	0.48	0.84	1.01	0.47	0.45	0.91	0.45
FI(ii)	0.41	0.82	1.01	0.4	0.38	0.89	0.38
FR(i)	0.5	0.73	0.98	0.45	0.42	0.85	0.41
FR(ii)	0.46	0.72	0.98	0.44	0.39	0.84	0.39
GR(i)	1	1.07	1.07	0.92	0.92	1.02	0.92
GR(ii)	1.05	1.06	1.08	1.03	1.11	1.17	1.12
IE(i)	0.9	0.89	0.97	0.79	0.78	0.81	0.73
IE(ii)	0.86	0.83	0.95	0.71	0.72	0.77	0.65
IT(i)	0.97	1.01	0.96	0.59	0.72	0.5	0.47
IT(ii)	0.93	0.95	0.96	0.59	0.66	0.48	0.46
NL(i)	0.47	0.82	1.01	0.46	0.44	0.91	0.44
NL(ii)	0.4	0.82	1	0.39	0.36	0.89	0.35
PT(i)	1	1.02	1	0.87	0.85	0.79	0.79
PT(ii)	0.99	1.02	1	0.87	0.83	0.75	0.74

Source: Dunne (2018) and ESRB calculations.
Note: The table quantifies the effectiveness of SBBS in hedging price movements in single-name sovereign bonds. Rows labelled (i) contain the ratio of the standard deviation of hedged returns relative to unhedged returns. Rows labelled (ii) contain the average of the ratio of the 95th and 5th quantiles of the distributions of hedged returns relative to unhedged returns. In each case, the best single hedge is shown in blue.

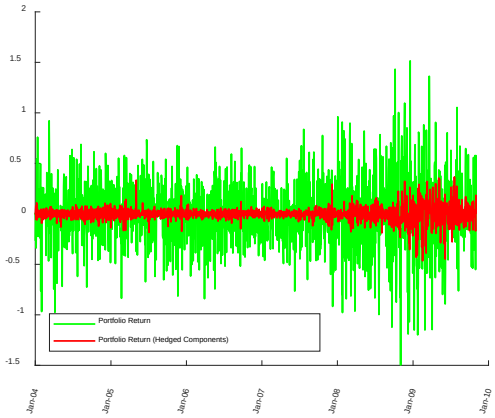
Figure 4.12

Portfolio returns with and without hedged components

a) Before the crisis (hedge: senior)

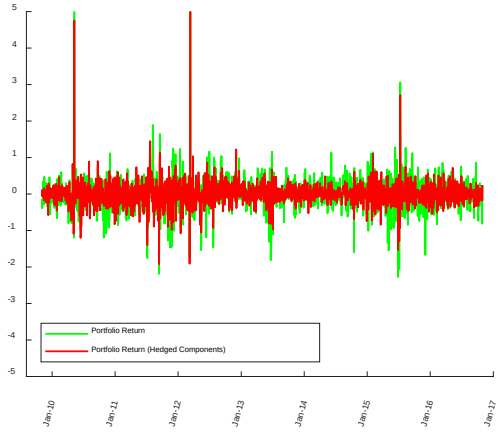


b) Before the crisis (hedge: senior and mezz)



c) During and after the crisis (hedge: senior)

d) During and after the crisis (hedge: senior and mezz)



Source: Dunne (2018) and ESRB calculations.

Note: The figure indicates the effectiveness of SBBS in hedging price movements in a diversified portfolio of sovereign bonds. The single hedge involves just senior SBBS. The composite hedge involves senior and mezzanine SBBS. The returns are measured in percentage points (vertical axis). The red areas relate to the hedged returns distribution. The green areas denote the unhedged returns distribution.

5 Regulatory policy

This section deals with regulatory considerations for SBBS, providing more technical detail than that which is contained in the corresponding chapter in Volume I. At present, SBBS would be treated as securitisations. As such, they would receive unfavourable treatment compared with the underlying portfolio of sovereign bonds. This represents a powerful obstacle to the natural emergence of SBBS. Yet SBBS represent a sui generis product. They are not subject to many of the risks of standard securitisations (e.g. opaqueness and lack of price data for the underlying assets and asymmetric information between the arranger and investors). Hence, SBBS warrant product-specific treatment. In addition, the outcome of ongoing discussions on the regulatory treatment of sovereign exposures (RTSE) will have implications for investor demand for SBBS.

5.1 Treatment of SBBS under the existing regulatory framework

This section outlines the implications for banks, insurance corporations and pension funds of treating SBBS as a securitised product. It also highlights the impact that investment, liquidity and collateral rules would have on the treatment of SBBS under existing regulation.

SBBS as securitised products

Under the current regulatory framework, SBBS would be treated as securitised products because they embed a seniority structure due to tranching. In regulation, this defines a securitised product, regardless of the underlying composition or risk.[52] Consequently, SBBS would receive a generally unfavourable treatment compared with the underlying sovereign bonds, thereby putting SBBS at a disadvantage.

The treatment of constructs other than securitisation would likely not apply to SBBS. They would not qualify as shares in a collective investment undertaking, which do not entail tranching and require that shares be redeemable at the request of the holder.[53] Similarly, SBBS cannot be treated as covered bonds because they do not have “double recourse” (i.e. to both the underlying assets and the issuer’s balance sheet), which is a key feature of covered bonds. SBBS are only backed by their underlying assets.

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[52] Article 4(61) of the CRR.

[53] The nature of collective investment undertakings is similar to securitisation insofar as they create a pool of assets and issue fund units or shares giving investors pro rata rights over the whole pool. A key difference, however, is that the pool of assets is dynamic, managed actively by an asset manager and determined by a predefined investment policy. It might be possible to define a fund whose investment policy is to hold sovereign bonds and have several classes of shareholders with defined distributions of interests. This cannot be considered as tranching, however, because share classes cannot be subordinated to one another. Another obstacle is that redemption requests are always based on the price of the common pool of assets. The condition of “redeemable upon request” may not be binding. Alternative investment funds may be conceived as closed-ended funds without redemption rights before termination of the fund or with redemption possible after five to 10 years.

SBBS would not qualify as a simple, transparent and standardised securitisation (STS) as defined under the new securitisation framework.[54] The new framework explicitly excludes securitisations of "transferable securities" (such as sovereign bonds) from the products that may qualify as STSs. This is because the framework aims to spur banks to originate new loans (especially to small- and medium-sized enterprises) in support of the real economy, as opposed to repackaging the debt of financial entities or government bonds. Moreover, no single underlying asset can exceed 2% of the total portfolio for a securitisation to qualify as STS.[55] In the case of SBBS, this limit would be exceeded by the sovereign bonds of 11 Member States.

Capital requirements for banks investing in SBBS as securitisations

For financial institutions, holding a securitised product rather than the underlying portfolio may give rise to higher capital requirements. The justification for such non-neutrality in the treatment of securitisations relative to that of the underlying portfolio comes from model risk (i.e. a higher sensitivity of the securitisation price to errors in estimating PDs, LGDs and default correlation of the underlying assets). Non-neutrality is also justified by agency risk, since securitisation involves a greater number of parties with potentially conflicting interests (e.g. servicing, counterparty, legal risk) than does holding the underlying assets.[56] Because of this non-neutrality, the total capital requirements imposed on senior, mezzanine and junior SBBS under current regulation would be higher than those imposed on holdings of the entire underlying portfolio of sovereign bonds.

In the Capital Requirements Regulation (CRR), there is generally a floor for the risk weight on securitisation positions of 7% for banks using the internal ratings-based (IRB) approach and 20% for banks using the standardised approach.[57]

As regards instruments held in the trading book, the risk weight to account for general risks would be similar for SBBS and sovereign bonds if they have the same duration and market value. For bonds held in the trading book, the treatment of specific risk in the standardised approach follows a look up table that assigns risk weights. In practice, this leads to a zero risk weight for specific risk.[58] Sovereign bonds held in the trading book are also subject to a small

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54 General framework for securitisation and creating a specific framework for simple, transparent and standardised securitisation, and amending Directives 2009/65/EC, 2009/138/EC and 2011/61/EU and Regulation (EC) No 1060/2009 and (EU) No 648/2012 and amendments to Regulation (EU) No 575/2013 on prudential requirements for credit institutions and investment firms.

55 Article 243(2) of the CRR as amended by Regulation EU 2017/2402.

56 A third factor justifying non-neutrality in typical securitisation is that the underlying securitised loans are not exposed to market risk (since they are not tradable), in contrast with the securitised product. This is not the case for SBBS.

57 See Regulation (EU) No 575/2013, Articles 242-270. In some cases (e.g. Articles 252 and 260 of the CRR), caps may be allowed that could result in lower risk weights for SBBS than the floors mentioned here. Similarly, the new securitisation framework will allow IRB banks (and to a certain extent also standardised approach banks) that are capable of assessing the risk characteristics of each individual asset in the underlying pool to apply a maximum capital requirement for securitisation positions equal to the capital requirements if the underlying exposures had not been securitised, or to apply a "look-through" approach (Articles 267 and 268 of the CRR as amended by Regulation EU 2017/2401). Depending on the risk weights of the underlying exposures, this could imply a lower risk weight than the floor, including for non-senior SBBS. It should be borne in mind that some IRB banks have a risk weight on their sovereign exposures higher than 0%. Thus, the risk weights for senior SBBS would not necessarily be 0% even if the cap is applied.

58 Article 336 of the CRR (Table 1) translates a 0% risk weight in the banking book into a 0% risk weight in the trading book.

capital charge for interest rate risk. By contrast, securitised products need to be funded by capital equal to 8% of the amount calculated under the banking book.[59]

IFRS 9 may provide some incentives to hold SBBS instead of sovereign bonds. Changes in the market value of financial instruments held in the trading book translate into immediate profits and losses. Implementation of IFRS 9 could accentuate this, as the valuation of assets under business models that build on selling the financial instruments are evaluated at "fair value through profit or loss" (FVTPL). Hence, financial instruments with lower volatility should be preferred by risk-averse investors as they need be less concerned about sudden capital shortfalls. If SBBS were highly liquid, this could translate into lower volatility.[60] At the same time, for investors whose business models concern only the collection of cash flows, SBBS could be accounted for at amortised cost.[61] While this would shelter them from immediate recognition of valuation losses, the new IFRS 9 impairment rules require provisions for possible losses with a one-year horizon. This impairment premium might be smaller for senior SBBS, given their in-built diversification.

As regards large exposure limits, SBBS would likely be assessed under the look-through approach. The exposure of an institution to an SBBS would thus be considered an exposure to a portfolio of sovereign bonds. The latter exposures are exempted from large exposure limits if they are attributed a zero risk weight in the calculation of capital requirements. In terms of the leverage ratio, SBBS and sovereign bonds would be treated in a similar way.

Capital requirements for non-banks investing in SBBS as securitisations

Insurance corporations

Solvency II allows two ways of calculating the Solvency Capital Requirement (SCR): an internal model (either full or partial) or the standard formula.[62] The standard formula defines explicitly which risks are to be taken into account in the SCR calculation. By contrast, internal models, which are subject to supervisory approval, give insurance corporations a high degree of flexibility in modelling. But there is a requirement to take into account all material, quantifiable risks that are in the scope of the model in the determination of the regulatory capital requirement.

Under the Solvency II standard formula, any securitisation is subject to capital requirements for spread risk in the calculation of the SCR. SBBS would therefore be subject to capital requirements for spread risk and put at a disadvantage relative to direct holdings of Member State

[59] Article 337 of the CRR.

[60] This might not be the case in times of crisis when demand for junior SBBS may decrease as investors prefer their own national sovereign bonds instead.

[61] This also relies on the SBBS being considered a debt instrument involving payments being made on specified dates in the form of principal and interest on the principal outstanding.

[62] See Commission Delegated Regulation (EU) 2015/35. There is also the option of using undertaking-specific parameters. As their application is not allowed for market risk, they are not considered further.

central government bonds denominated and funded in domestic currency (which would not be subject to such requirements).[63]

A general look-through approach in the standard formula exists under Solvency II for exposures to investment funds, but not for securitised products. Nevertheless, there is a "partial look-through" requirement resulting from the fact that securitisations have to be included in the calculation of the capital requirements for interest rate risk.

Under Pillar 2 of the Solvency II framework, and irrespective of the method used to calculate their SCR, insurance corporations have to determine their overall solvency needs in the "own-risk and solvency assessment" (ORSA).[64] In the assessment of their own solvency needs, insurance corporations must also consider risks not covered by the standard formula.[65]

Pension funds

Capital rules for pension funds are not harmonised at EU level. In particular, applying capital requirements to securitised products is at the discretion of national legislators. However, Directive 2003/41/EC[66] and its recast Directive (EU) 2016/2341[67] lay down minimum rules and principles for valuing assets and liabilities as well as funding requirements. Article 15 of Directive (EU) 2016/2341 sets out that institutions for occupational retirement provision (IORPs) (not the sponsoring undertaking) underwriting the liability to cover against biometric risk, or guaranteeing a given investment performance or a given level of benefits, are subject to a regulatory own funds requirement, under which they must hold additional assets above the technical provisions to serve as a buffer. The amount thereof should reflect the type of risk and the portfolio of assets with regard to the total range of schemes operated. That requirement can be extended to all IORPs within a Member State, based on the option set out in Article 15(3) of Directive (EU) 2016/2341.

Investment rules and restrictions

Banks and insurance corporations may invest in securitised products if the arranger retains a material net economic interest in the issuance (sometimes referred to as a "skin-in-the-

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63 The size of this additional capital buffer depends on the type of securitisation: among other things, only senior securitisation tranches of sufficient credit quality, listed on a regulated market and containing only one pool of homogeneous exposures such as residential loans, receive the more favourable treatment of a type 1 securitisation position (see Article 177(2) of Commission Delegated Regulation (EU) 2015/35, which also defines further conditions, including that the underlying exposures do not include transferable financial instruments). But sovereign bonds are not included in the closed list of eligible underlying assets (see Article 177(2)(h) of Commission Delegated Regulation (EU) 2015/35). SBBS would therefore be classified as type 2 securitisation positions with a risk charge for the best credit quality of 12.5% multiplied by the modified duration (Article 178(2) of Commission Delegated Regulation (EU) 2015/35).

64 See Article 45(1)(a) of Directive 2009/138/EC (Solvency II).

65 According to Article 45(1)(c) of Directive 2009/138/EC (Solvency II), the deviation of the risk profile from the underlying assumptions of the SCR calculation under the standard formula needs to be assessed and reported in the ORSA report.

66 Directive 2003/41/EC of the European Parliament and of the Council of 3 June 2003 on the activities and supervision of institutions for occupational retirement provision.

67 Directive 2016/2341/EU of the European Parliament and of the Council of 14 December 2016 on the activities and supervision of institutions for occupational retirement provision (IORPs) (recast).

game" requirement).[68] Directive 2013/36/EU (Capital Requirements Directive (CRD IV)) and Solvency II, however, provide criteria for exceptions. Where the securitised exposures are exposures to a Member State central government denominated and funded in the domestic currency of that central government, or are fully guaranteed by a central government, they would not fall under this skin-in-the-game requirement.[69]

Directive 2011/61/EU on Alternative Investment Fund Managers (AIFMD) only allows alternative investment funds to invest in securitised products if arrangers retain a material net economic interest; however, the same exemptions offered by CRD IV are also available under the AIFMD.[70] The same rule does not yet apply to undertakings for collective investment in transferable securities (UCITS), but rules will become consistent across sectors with the new securitisation framework, which broadens the scope of the retention rule to all institutional investors in securitised products. There are a number of qualitative requirements in the AIFMD that the investment funds are expected to fulfil,[71] although these should not materially restrict alternative investment funds from investing in SBBS.

UCITS need to comply with diversification rules, which may prevent them from holding large volumes of SBBS. While Member States may authorise UCITS to invest up to 100% in transferrable securities issued or guaranteed by a public body, this exception may not be available for SBBS.[72]

CCPs may in principle be able to invest in SBBS under current rules if they are considered to be highly liquid. In line with their investment policies, however, they would probably not be able to invest in junior SBBS, since these securities would be perceived as too risky.

For insurance corporations, Solvency II sets out specific due diligence and risk management requirements for securitisation positions, in addition to the general prudent person principle.[73] When managing their investments, insurance corporations have to consider all relevant risks irrespective of whether they are included in the SCR calculation.

For IORPs, Article 19 of Directive (EU) 2016/2341, which was adopted in December 2016 and is to be transposed into national law by 2019, sets out provisions in relation to the prudent person rule. In particular, it calls for the assets to be invested in the best long-term interests of members and beneficiaries as a whole. In the case of a potential conflict of interest, an IORP, or the entity which manages its portfolio, is required to ensure that the investment is made in the sole

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68 Article 254 of Commission Delegated Regulation EU No 2015/35 and Article 405(1) of the Regulation (EU) No 575/2013

69 Article 255 of Commission Delegated Regulation EU No 2015/35 and Article 405(3) of the Regulation (EU) No 575/2013.

70 Article 17 of Directive 2011/61/EU (AIFMD), further specified in Article 51 of Commission Delegated Regulation (EU) No 231/2013.

71 Article 17 of Directive 2011/61/EU (AIFMD), further specified in Articles 52 and 53 of Commission Delegated Regulation (EU) No 231/2013.

72 Directive 2009/65/EC (UCITS) imposes diversification on UCITS. Although Article 54 derogates from Article 52 and the principle of risk-spreading to allow investments up to 100% in transferable securities issued by the same entity (i.e. same issuer or same guarantor), SBBS are currently not listed as possible beneficiaries of this exemption. Moreover, there is a requirement of diversification across different maturities.

73 Article 4(5) and (6) of Commission Delegated Regulation EU No 2015/35 requires insurance corporations to produce their own internal credit assessment for type 2 securitisations. Article 256 sets out due diligence and risk management requirements including stress testing for securitisations.

interests of members and beneficiaries. Investments in assets issued by the same issuer or by issuers belonging to the same group must not expose an IORP to excessive risk concentration. Member States may choose not to apply the diversification requirements to investments in government bonds.

Based on the Member State option set out in Article 19(6)(a) and (7) of Directive (EU) 2016/2341, Member States may impose more stringent investment rules. This may include quantitative restrictions for securitisations. Article 25 of Directive (EU) 2016/2341 specifically mentions the need for an IORP's risk management system to address in a proportionate manner risks which can occur in the area of investments, in particular derivatives, securitisations and similar commitments, where applicable.

As the EU rules apply to financial institutions domiciled in the EU, investors from outside the EU will be subject to different regulations. The Dodd-Frank Act in the United States has similar risk-retention rules, with a number of exceptions to the 5% benchmark and special treatments for various financial products.

Liquidity and collateral

While senior (and possibly mezzanine) SBBS might become at least as liquid as some sovereign bonds, they would not presently qualify as level 1 assets under the liquidity coverage ratio (LCR) by virtue of their status as securitised products. At present, securitised products are not recognised as level 1 assets. Senior tranches of ABS can be level 2b assets and subject to a 25% minimum haircut under specific criteria set out in Commission Delegated Regulation (EU) 2015/61. However, SBBS would not meet these criteria because sovereign bonds are not included in the list of eligible underlying exposures.[74] This also affects their treatment under the net stable funding ratio requirement, which adopts the same definition of liquid assets as the LCR.

A central determinant of the liquidity of a financial asset is whether it can be used as collateral. Government bonds are used heavily as collateral and in securities lending. Utilisation rates are about 50% for German, 30% for French and 15% for Italian sovereign bonds. The monetary advantage of being eligible for use as collateral would be around 15 basis points, when euro area average fees for securities lending are taken as a proxy, and close to 20 basis points for German and French sovereign bonds.

The Financial Collateral Directive (Directive 2002/47/EC) makes no distinction between bonds and securitised products, meaning that it protects them legally in the same way. In practice, market data on the use of collateral in repurchase transactions suggest that only a small share use securitised assets as collateral. Securitised products are also not part of any global collateral baskets of major CCPs.

[74] Article 13(2)g of Commission Delegated Regulation EU No 2015/61.

Whether CCPs could accept instruments such as SBBS as collateral would depend on whether the securities can be considered low credit risk and highly liquid, as defined in the annex to Commission Delegated Regulation 153/2013.[75] Conditions include an active outright sale or repurchase agreement market and reliable price data. SBBS should be able to fulfil these conditions in general. Senior SBBS would also be eligible collateral for uncleared derivatives.[76]

A central securities depository (CSD) can accept instruments from its client accounts as collateral when providing bank-like ancillary services. In addition to debt instruments issued or guaranteed by a government,[77] a CSD can accept other types of collateral that are eligible at a central bank where the CSD banking service provider has access to regular, non-occasional credit from that central bank.

Eligibility as collateral in central bank operations appears a necessary, but not sufficient, condition for the use of SBBS in private repurchase transactions. Securitisations are treated differently from bonds in the ECB's current collateral framework: (i) a securitisation of government bonds per se is presently not foreseen to be eligible; (ii) all securitisations presently command by default a 15% minimum haircut.

Other rules relating to SBBS arranger(s)

The obligation for arrangers of securitisations to retain at least 5% of the issuance as skin in the game does not apply because the securitised exposures are guaranteed by central governments or other public bodies.[78] The retention obligation was introduced to account for the agency cost in securitised products, reflecting the information disadvantage that investors have vis-à-vis the originator and the underlying pool. This motivation is hardly relevant for SBBS.

If arrangers were banks, they would be subject to capital requirements for credit risk. However, the securitisation framework allows an arranging bank to apply a maximum capital requirement for the securitisation position it holds equal to the capital requirements that would be calculated in respect of the underlying exposures had they not been securitised.[79] The rationale for this provision is that, from the perspective of the arranger, a securitisation – to the extent that it results in a significant transfer of risk to the buyers of the tranches – should not result in a higher risk than would have been the case had the arranger kept the underlying assets. In practice, therefore, under the current regulatory treatment of sovereign bonds, an originating bank which

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75 Annex II lists the following conditions for highly liquid instruments: (a) they are issued or explicitly guaranteed by: (i) a government; (ii) a central bank; (iii) a multilateral development bank; (iv) the European Financial Stability Facility or the European Stability Mechanism where applicable; (b) low credit and market risk based upon an internal assessment by the CCP; (c) the average time-to-maturity of the CCP's portfolio does not exceed two years; (d) they are denominated in one of the listed currencies; (e) they are freely transferable and without any regulatory constraint or third party claims that impair liquidation; (f) they have an active outright sale or repurchase agreement market; (g) reliable price data on these instruments are published on a regular basis.

76 EMIR Commission Delegated Regulation Article 4(1)o.

77 See Articles 9 to 11 of the EBA's regulatory technical standards on certain prudential requirements for central securities depositories.

78 Article 405(3) of the CRR describes exemptions from the retention rule specified in Article 405(1) of the CRR.

79 Articles 252 and 260 of the CRR and Article 268 of the CRR as amended by Regulation EU 2017/2401.

uses zero risk weights for euro area sovereign bonds would not face additional capital requirements from arranging and issuing SBBS.

One further issue that needs more consideration is whether, and under what conditions, the arranger can derecognise securitised assets in its balance sheet. If a private arranger of SBBS is a bank and cannot deconsolidate the balance sheet of the issuing entity, its leverage ratio would increase.

5.2 Treatment of sovereign exposures and securitisations under Pillar 2 and bank stress tests

As highlighted by the ESRB (2015), regulatory treatment differs according to the specific risk being addressed, be it credit, market or even concentration risk. The treatment of sovereign exposures is typically addressed directly in the Pillar 1 capital requirements (i.e. mandatory capital requirements for all banks), but additional supervisory tools are available, such as Pillar 2 (i.e. bank-specific assessment and measures performed and imposed by supervisors) and EU stress tests. This section considers in more detail the Pillar 2 and stress tests frameworks in the context of both sovereign exposures and securitisations in general and SBBS in particular.

Limited evidence is available of actual supervisory actions in Pillar 2, making it difficult to provide a comprehensive review. As regards sovereign risk in particular, the supervisory actions taken seem to have been limited. Stress tests of sovereign risk have focused on losses incurred on portfolios measured at fair value (i.e. available-for-sale (AfS), fair value option (FVO) and held-for-trading (HFT) portfolios) under a stress scenario. Emphasis has therefore been given to price losses due to market movements under a stress scenario rather than credit risk losses. Generally, a securitisation of sovereign bonds would be treated less favourably than the same portfolio of sovereign bonds, although a direct comparison is not straightforward due to differences in the accounting classification that is typically given to these exposures. The sections below describe in more detail the Pillar 2 framework and stress tests for sovereign exposures.

Pillar 2 principles

The European Banking Authority (EBA) is mandated to foster sound and effective supervision and to drive supervisory convergence across the EU arising from the requirements specified in CRD IV. To this end, Article 107 of CRD IV mandates the EBA to draw up guidelines for competent authorities (CAs) to specify, in a manner that is appropriate to the size, structure and internal organisation of institutions and to the nature, scope and complexity of their activities, the common procedures and methodologies for the supervisory review and evaluation process (SREP) and for the assessment of the organisation and treatment of the risks.

Such guidelines were issued by the EBA in 2014 and have been in force since 2016.[80] However, the guidelines only touch on the issue of the RTSE to a limited extent, leaving room for different approaches by Member States.

The EBA's SREP guidelines provide guidance on risk assessment and capital adequacy. In particular, they requires CAs to consider all material risks to which institutions are or may be exposed and, in accordance with their supervisory powers, to determine additional own funds requirements (Pillar 2 capital requirements) for those risks which are not covered under minimum own funds requirements or elements thereof pursuant to Article 104(1)(a) CRD IV.

The common SREP framework is built around the following four blocks of analysis:

(a) business model analysis;

(b) assessment of internal governance and institution-wide control arrangements;

(c) assessment of risks to capital and adequacy of capital to cover these risks;

(d) assessment of risks to liquidity and adequacy of liquidity resources to cover these risks.

Risks related concentration in sovereign exposures and securitisations will normally be assessed under block (c). The assessment can take two forms:

- qualitative and quantitative assessment of the material risks that the institution is or might be exposed to, in terms of both risk exposure and the quality of management and controls employed to mitigate the impact of the risks;
- assessment of capital adequacy with a view to determining the quantity and composition of additional own funds required to cover risks that are not fully captured by existing capital buffers, and whether own funds requirements can be met over the economic cycle.

One of the main sub-categories considered under credit risk is country risk, for which CAs should assess the degree of concentration arising from all types of exposures, including sovereign exposures. In the case of material concentrations, supervisors are expected to determine capital add-ons to address this particular risk, since it is not covered by minimum own funds requirements.

Credit risk from securitisation represents another category. In this case, the CAs should assess the appropriateness of the allocation of securitisation exposures to the banking book and trading book; whether the appropriate regulatory treatment is applied to securitisations; the rating and the performance of the securitisations held by the institution; and the nature, composition and quality of the underlying assets. Finally, when determining institutions' capital adequacy, CAs should consider any inter-risk concentrations, which may arise from holding sovereign exposures in both the banking and trading book, for example.

[80] See **https://www.eba.europa.eu/regulation-and-policy/supervisory-review-and-evaluation-srep-and-pillar-2/guidelines-for-common-procedures-and-methodologies-for-the-supervisory-review-and-evaluation-process-srep-#**

The outcome of the overall SREP assessment should form the basis for taking any necessary supervisory measures (i.e. capital, liquidity or other measures) to address the identified concerns. The guidelines provide practical guidance on the application of the supervisory measures, including the application of additional own funds requirements, but do not suggest any automatic link between the scores and the level of supervisory response or additional own fund requirements.

The SREP guidelines are designed under the "Pillar 1 +" approach, which means that Pillar 1 minimum requirements cannot be reduced via any Pillar 2 supervisory measure. The various measures within a single risk category (credit risk and counterparty risk, market risk, operational risk, interest rate risk from trading activities) may cancel out each other, down to the minimum Pillar 1 requirements. However, no diversification is possible across the risk categories.

Sovereign exposures

Generally, sovereign exposures and concentration risk can be considered areas that are not fully covered by the CRR due to the exemption of sovereign exposures from credit risk capital requirements and the large exposure framework. Therefore, cases where institutions are overly exposed to one of these risks should normally entail an assessment of the adequacy of capital requirements.

Observing supervisory practices has so far revealed only a few cases where additional own funds requirements have been imposed for risks related to sovereign exposures. Nonetheless, in some instances institutions allocate internal capital to sovereign exposures or to country risk based on their own assessment (via the internal capital adequacy assessment process (ICAAP)), and such internal estimates may be considered by CAs when determining the level of additional capital requirements. Having conducted the assessment of the above SREP elements, CAs should form a comprehensive view on the risk profile and viability of the institution – the overall SREP assessment. The non-zero risk weight applied to sovereign exposures is therefore more common in the cases where, as part of the overall guidance from the supervisory authorities, sovereign portfolios are deliberately moved to the IRB under Pillar 1 (e.g. Belgium), or when it is used under IRB as part of the ICAAP under Pillar 2 (e.g. Sweden).

Stress tests

The objective of the EU-wide stress test is to provide supervisors, banks and other market participants with a common analytical framework to consistently compare and assess the resilience of EU banks and the EU banking system to shocks, and to challenge the capital position of EU banks. The exercise is based on a common, internally consistent methodology and EBA data.

This section focuses on the treatment of sovereign exposures and securitisations based on the methodology of the stress test conducted in 2016. More details on the methodology can be found on the EBA website.[81] In general, there are two ways of applying stress to exposures held by a bank. The first way is by imposing losses, through impairments and value adjustments that would ultimately feed into bank capital. The second way is by increasing the risk exposure amount (REA). In the EBA stress test in 2016, risks arising from sovereign exposures were covered under the credit risk or market risk section, depending on their accounting treatment.

Under credit risk, banks are asked to estimate default and impairment flows for sovereign positions recorded as loans and receivables and held-to-maturity (HTM) investments according to the macroeconomic baseline and adverse scenario (except central bank exposures, for which zero loss rates apply). In order to compute these impairment flows for the IRB and standardised approach to sovereign exposures, banks were provided with a set of stressed probability-of-default and loss-given-default parameters developed for a selection of countries.

Fair value positions are subject to the market risk approach. Thus, sovereign positions in AfS and FVO portfolios are subject to market risk parameters (mark-to-market) and haircuts to cover market volatility in 2016. The haircuts are derived from two components – interest rates and credit spreads. Haircuts are applied to direct exposures only. Whenever available, banks are required to use the haircuts provided. For countries or regions for which no haircuts are provided, banks should apply the macroeconomic adverse market risk scenario. The stress for the hedging positions corresponding to direct exposures in the banking book should be based on the application of the same risk factor shocks (i.e. interest rates and credit spreads only) as for the related hedged sovereign positions.

Banks should apply the market risk methodology and the market risk parameters for the projection of losses of the sovereign positions in HFT portfolios (mark-to-market). Projections should be consistent with those of non-sovereign HFT positions. Haircuts applicable to AfS and FVO sovereign positions should not be applied to HFT positions, but the two components of the haircut – interest rates and credit spreads – should be taken into account when deriving the appropriate impact.

As regards risk-weighted assets, given that sovereign exposures are generally treated with a 0% risk weight, the application of stress to the sovereign exposures will not increase risk weights under the current CRR treatment. The capital impact from the stress test will thus only apply through the profit and loss adjustments. The treatment of securitisations, which is outlined in more detail in Box 5.A, is unfavourable compared to this treatment of the underlying sovereign exposures.

The profit and loss adjustments imposed through the impairments and value adjustments of a stressed scenario will be the same for both a portfolio of sovereign exposures and SBBS. This is because the losses of the securitisation are calculated on the assets underlying the securitisation (i.e. the look-through approach). In addition to profit and loss adjustments, however, and unlike the case of a portfolio of underlying sovereign exposures, securitisations call for

[81] **https://www.eba.europa.eu/documents/10180/1259315/2016+EU-wide+stress+test-Methodological+note.pdf**

increased capital requirements in the stress scenario, as their credit rating will (be assumed to) worsen.

Hence, the EBA stress test (2016) leads to sovereign bond holdings being treated more favourably than SBBS in terms of risk weights and to similar treatment in terms of losses. It is difficult to compare the effects of stress testing sovereign exposures versus securitisations because securitisations are typically held in HTM portfolios, which is not usually the case for sovereign bonds. Nevertheless, as currently designed, stress test are unlikely to result in securitisations being treated more favourably than the underlying exposures because of the increase in risk weights that arises due to the securitisation. In future, however, this depends on the regulatory treatment of SBBS.

Possible changes to RTSE under Pillar 2

This section looks at several methodologies for calculating the supervisory benchmarks for concentration risk capital requirements which could be applied in stress-testing methodology and could feed into guidance for Pillar 2 requirements. In some cases, existing Pillar 2 guidance has already developed supervisory benchmarks that allow supervisors to challenge banks' own Pillar 2 internal capital requirements (ICAAP). The use of such benchmarks may also be relevant for sovereign exposures as a tool to guide supervisory approaches (without automatically generating additional capital requirements).

Sovereign exposures are in many cases exempted from the application of supervisory benchmarks for concentration risk. The quantitative results should therefore be seen as indicative. Moreover, even if the current methodologies for concentration risk capital charges applied to sovereign exposures, the capital add-on in Pillar 2 guidance would vary across countries, mainly as a result of the different methodologies applied. This is due to the fact that methodologies are often calibrated to capture corporate exposures, which are substantially less concentrated than sovereign exposures.

A more detailed cost-benefit analysis would be required to assess the level of risk weights and calibration of other formulae required to encourage such diversification in stress testing. However, it can be concluded that, should concentration charges be introduced in Pillar 2, reform in the treatment of sovereign exposures can include concentration risk measures with simple or well-established methods. Furthermore, harmonisation in the methodologies that address concentration risk charges is likely to create a regulatory environment in which the demand for senior SBBS is higher due to the increased capital requirements associated with more concentrated portfolios. Whether the introduction of such measures is desirable requires further consideration and is outside the scope of this report.

Box 5.A
Treatment of securitisations in stress tests

Originator positions where no significant risk transfer (SRT) has taken place are to be treated under the general credit risk methodology and not under the securitisation credit risk methodology. Securitisation exposures within correlation trading portfolios (generally very few) are covered by the market risk methodology and must be reported within market risk. Exposures with SRT that are not in the correlation trading portfolio fall under the securitisation credit risk methodology.

For held-to-maturity (HTM) assets, banks are required to estimate impairments for securitisation exposures that are not subject to mark-to-market valuation. For securitisation exposures subject to mark-to-market valuation (i.e. AfS, FVO, and HFT), banks are required to estimate the impact on their profit and loss account via the mark-to-market loss incurred as a result of the impact of the scenarios according to the market risk methodology.

For the estimation of the REA in the context of securitisation credit risk methodology (i.e. all accounting portfolios except the HFT with correlation trading portfolios), the stress is applied to securitisation positions in the banking and trading books according to their regulatory treatment.

- For regulatory approaches based on risk weights (i.e. the IRB and standardised approach methods, except exposures under the supervisory formula), a fixed risk weight increase will be applied to the different credit quality steps by substituting the original risk weights with higher ones. The increased risk weights reflect the effect on the REA of rating migrations.
- Securitisation positions should be stressed according to the previous paragraph when external ratings are not available and banks use the internal assessment approach for REA calculation purposes. Each securitisation position should be assigned the credit quality step whose average risk weight is closest to that in the securitisation contract concerned.
- When they use the supervisory formula approach for REA calculation purposes, banks should apply the stress factors for unsecuritised corporate or retail exposures to the risk components (PD, LGD) of the asset pool in the respective exposure class. In this case, as a precondition, IRB banks have to demonstrate to the respective competent authority that the internal methods can be adjusted in a way that is consistent with the scenarios

In the case of HFT positions with correlation trading portfolios, stressed REAs are calculated based on Articles 368 and 377 of the CRR.

5.3 Drivers of demand for SBBS relative to sovereign bonds under current regulation

This section explores several sources of potential advantage from investing in SBBS relative to a portfolio of sovereign bonds under current regulation. In particular, it explores four potential sources of relative advantage: (i) capital requirements against trading exposures; (ii) usability as collateral in private repos; (iii) transaction costs and (iv) liquidity. The general conclusion is that there are no advantages accruing to SBBS that are sufficient to offset their generally unfavourable treatment under current regulation.

1. Capital requirements against trading exposures

SBBS represent single securities, while a portfolio of the underlying sovereign bonds held directly would naturally consist of several securities. However, no provisions exist in regulation that would give rise to a favourable treatment of SBBS due to the bundling that is inherent in their design.[82] Moreover, it should be borne in mind that, at least in the steady state, the SBBS would be composed of underlying bonds with similar features, such as the same (or broadly similar) residual maturity. This would further narrow any scope for differential capital requirements.

2. Usability as collateral in private repos

For banks, the use of SBBS as financial collateral for private repurchase transactions would largely depend on their eligibility under the credit risk mitigation framework. From this perspective, SBBS are expected to meet all the general requirements listed in Article 207 of the CRR. However, this would not differentiate SBBS from the underlying portfolio of sovereign bonds, which also meet the general requirements for financial collateral under the credit risk mitigation framework. On this basis, SBBS would be on equal footing with individual sovereign bonds.

Financial collateral would still be subject to volatility adjustments, both for collateral used under master netting agreements (Articles 220 and 221 of the CRR) and under the Financial Collateral Comprehensive Method (Article 223 of the CRR). If senior SBBS had lower price volatility than most of the underlying sovereign bonds, this could in principle provide a direct advantage to senior SBBS. Nevertheless, according to Article 227 of the CRR, the volatility adjustment for repo transactions may be ignored for short-term exposures if the collateral is composed of sovereign bonds or if both the collateral and the exposure are subject to daily re-valuation or re-margining. In the latter case, the lower volatility of senior SBBS compared to the underlying sovereign bonds would provide significant benefits in the shape of reduced re-valuation and re-margining. Similarly, valuation adjustments may provide meaningful differentiation for SBBS for collateral used to cover

[82] Some provisions do exist, but their impact is difficult to assess in general terms and unlikely to be large. For example, Article 176 Directive 2009/138/EC (Solvency II) regulates the link between the maturity of an instrument in a trading book and capital requirements. It envisages a stepwise linear relationship with a minor kink at five years, which makes for an overall weakly concave function. This implies that SBBS with a five-year maturity would actually have slightly higher capital charges than a portfolio of underlying bonds with a five-year average maturity (provided not all the underlying bonds have the same five-year maturity, in which case the charges would be similar). Article 339 of the CRR provides for a weight (upward-sloping) and an "assumed interest rate change". The product of both is multiplied by the price of the bond. This produces kinks in the relationship, but these are dependent on the actual yield curve, so differential treatments would arise ex post but are not determined ex ante.

initial and variation margins for over-the-counter (OTC) derivatives (see the Regulatory Technical Standard on risk mitigation techniques for OTC derivative contracts not cleared by a CCP, Articles 29 and 30 of the CRR).

3. Transaction costs

The transaction costs associated with trading SBBS depend on their final design features and the liquidity of the market in which they are traded. In principle, a large and well-functioning market for SBBS could offer lower transaction costs than certain sovereign bond markets. However, transaction costs in sovereign bond markets are generally low, so any differential advantage would be limited,[83] Moreover, additional costs can arise in the case of SBBS, depending on the issuance model that is adopted. These could include structuring costs (including legal costs and warehousing costs), operating and servicing costs (which should be low in the case of actively traded and transparent sovereign bonds), and fees for third-parties to the securitisation (depending on the complexity of the transaction). An important question is whether these costs are covered fully or partly by the positive excess spread generated by the structuring and, if not, whether the residual costs would be completely passed on to final investors or absorbed at least in part by the arranger.

The size of the excess spread depends on several factors, such as the composition of the underlying pool and the seniority structure. These include: the liquidity of SBBS compared with the underlying sovereign bonds; the degree to which "ratings optimisation" by SBBS arranger(s) produces securities that are better suited to investors' preferred risk habitats; the operational costs associated with setting up and maintaining the structure; the costs borne by arranger(s) in assembling sovereign bonds in primary or secondary sovereign bond markets; the degree to which investors demonstrate "novelty aversion" with respect to SBBS, particularly in an early phase of market development; the extent to which the diversified nature of SBBS crowds-in demand from investors resident outside of the euro area; the non-pecuniary value of SBBS as financial collateral in OTC derivatives transactions or repo transactions with private institutions or a central bank; and the regulatory treatment of SBBS compared with sovereign bonds. The direction and magnitude of these effects would determine the attractiveness of trading SBBS relative to sovereign bonds (except insofar as positive excess spread is used to provide additional credit enhancement to SBBS, for instance in the form of a funded reserve account).

On the second issue, the cost of assembling the portfolio would be borne by arranger(s). If arranger(s) are profit-maximising, they would likely pass on costs to final investors, who would receive correspondingly lower returns. The extent of the pass-through to final buyers would depend on several factors, including the degree of competition among arranger(s). If there are substantive economies of scale in assembling the portfolio, a single arranger could emerge in equilibrium. For political economy reasons, such a monopsony would likely need to be a public entity in the context of an institutional framework that ensures no mutualisation of sovereign risks. In this case, part of the costs of SBBS issuance could be covered directly by the arranger. This would reflect the "public good" properties of (senior) SBBS in enhancing financial stability. Although some agents (especially

[83] Average bid-ask spreads are less than 0.5% of the mid-price in the EU (and around 0.1% in the United States). It should be borne in mind that the amount of savings on transaction costs would also depend on the extent to which SBBS differ from individual agents' optimal portfolio allocation, as optimising investors could be expected to supplement the SBBS portfolio with individual bonds or credit protection.

small banks and investors) may lack the infrastructure or operational capability to manage a diversified portfolio of sovereign exposures, they may nevertheless benefit from the availability of a predefined, diversified product, even if they need to pay for the service. As regards junior SBBS, high-yield investors may value its built-in, low-cost leverage.

Another possibility is that investors would prefer to hold sovereign bonds directly because they could then fine-tune the portfolio composition. With SBBS, by contrast, the underlying portfolio composition is "pre-cooked", although risk exposures could still be fine-tuned by selling certain sovereign bonds long or short (e.g. by selling or buying credit protection in derivatives markets). Overall, investors' preferences for SBBS versus sovereign bonds depends on the purpose for which these securities are held, be it as part of a proprietary short-term trading strategy, as buy-to-hold investments, for market-making activities, or for liquidity or collateral management. Banks could be expected to favour senior SBBS for liquidity and collateral management and for buy-to-hold investments. From this perspective, replicating the low-risk properties of senior SBBS that give rise to their attractiveness would require banks to apply contractual subordination to a diversified portfolio of sovereign bonds and then immediately offload non-senior SBBS. This procedure would be cumbersome for institutions that do not have a comparative advantage in arranging SBBS, implying that manufacturing SBBS in-house (by buying the underlying sovereign bonds and then performing the securitisation) would not give investors greater flexibility than buying SBBS. Thus, it would seem that SBBS would not have less appeal than the underlying portfolio of bonds on these grounds.

4. Liquidity

In terms of liquidity, there is a potential source of differential appeal for SBBS if the market were to reach a large scale. A market of €1.7 trillion for senior SBBS, for example, would be larger than any individual sovereign bond market in the euro area, and presumably would attract correspondingly greater liquidity. In such a scenario, senior SBBS could become the benchmark liquid sovereign exposure. To reach this point, however, it would be necessary to remove the regulatory barriers that currently impede the development of SBBS. The next section discusses the principles that could inform regulatory reform in this direction.

5.4 Enabling product regulation for SBBS

As highlighted in Section 5.1, SBBS would be subject to unfavourable treatment under current regulation relative to government bonds because they would be treated as a securitised product. Since SBBS would be relatively straightforward to replicate, this unfavourable regulatory treatment is a powerful obstacle to their demand-led emergence.[84]

Presently, there is no regulation that adequately reflects all characteristics of SBBS. The regulatory framework for securitisations does not envisage a specific product like SBBS. Therefore, a new, appropriate regulatory treatment reflecting the unique characteristics of SBBS seems warranted insofar as the existing treatment is inappropriately unfavourable.

Many of the features that render securitised products risky would not be present in the case of SBBS, negating the typical justification for non-neutrality. This includes opaqueness of the underlying assets and absence of market prices to value them. In particular, the underlying assets in the case of SBBS would be well known and understood by final investors, and the fact that the composition of the underlying pool is predefined excludes adverse selection issues. By contrast, in traditional securitisations, arranger(s) may face incentives to package assets of inferior quality, which justifies minimum retention rules. The transparency of SBBS would be ensured by the fact that the underlying assets – central government bonds – are well known, liquid and tradable securities.

Two main regulatory interventions may be warranted to create the conditions for SBBS to be placed on the market:

1. **Issuing a new product regulation that defines the characteristics of SBBS in standalone legislation.** These rules should set out the conditions for a product to be classified as SBBS and, consequently, subject to a regulatory treatment that reflects their unique design and risk properties.

2. **Modifying, as needed, parts of existing legislation** on different financial sectors to ensure that SBBS obtain risk-adequate treatment.

The remainder of this section assumes that SBBS would be issued by an independent entity that backs the issuance of securities of different seniority by a static underlying portfolio of sovereign bonds. Some adjustments might be needed if the features of SBBS were different (e.g. the specific provisions that may require amendment to establish the desired regulatory consistency with sovereign bonds). The regulatory principles, however, would not change.

[84] Section 5.3 explores drivers that could generate demand for SBBS (or, at least, for senior SBBS), thus potentially offsetting this regulatory disadvantage. It finds that, especially under the current RTSE, such drivers are few (e.g. clientele effects; savings on transaction costs, especially for small banks; etc.) and are in and of themselves unlikely to support a successful launch of SBBS.

Principles of a new product regulation

A dedicated product regulation would need to reflect the unique design and risk properties of SBBS. Such a regulation would specify that only products qualifying as SBBS – notably in terms of portfolio composition and seniority structure – would benefit from the regulatory treatment envisaged for SBBS. The regulatory treatment of SBBS should not apply to imitations of SBBS, such as products that securitise a different pool of sovereign bonds.

Eligibility criteria for a product to be classified as SBBS:

(a) **The assets to be included in the pooled portfolio should only be central government debt securities** (no sub-national debt) issued by participating Member States that issue eligible securities for which there is a market-clearing price. This would be assessed by a certifying entity empowered by the SBBS-specific enabling regulation. The entity would assess the existence of a market-clearing price solely for the purpose of determining the composition of the portfolios underlying SBBS.

(b) **The benchmark for the composition of the portfolio would be the ECB capital key.** Regulation would define the weights (with narrow tolerance bands) that would need to be adhered to by SBBS arranger(s). This is explained in Volume I.

(c) **The seniority structure should comply with ranges specified in the legislation** (e.g. a thickness of at least 70% for senior SBBS and no more than 10% for junior SBBS). The seniority structure is discussed in more detail in Section 1.

(d) **SBBS should be denominated in euro.** The SBBS cover pool may only include EU Member States whose currency is not the euro if they issue debt denominated in euro. This is explained in Volume I.

(e) **SBBS should be decoupled from bankruptcy risk of arranger(s).** SBBS issuers should be mere pass-through entities. This means, for example, that they would not enter into derivatives transactions or perform maturity transformations. The bankruptcy of SBBS arranger(s) should not affect pay-outs on SBBS, as described in Sections 2 and 4.

(f) **There should be a clear procedure to be followed in the event of sovereign debt restructuring.** This is described in more detail in Section 2.

Possible regulatory treatment of SBBS:

Where it meets all the requirements, a product would qualify as an SBBS and be subject to specific treatments in the different financial sectors, such as the following:

- **SBBS should be treated in a way that takes account of the relative risk levels of the three securities.** Based on the analysis in Section 1, holdings of senior SBBS could justify a risk weight of zero, or alternatively one that corresponds to the lowest credit quality step. The treatment of the mezzanine and junior SBBS should account for the risk that holdings of these securities would incur compared with the underlying portfolio. There are, in principle, at least two ways in which this could be achieved. First, mezzanine and junior SBBS could be

attributed a fixed risk weight (which could be specified as a surcharge over the risk weight of senior SBBS), depending on the regulatory treatment of the underlying sovereign exposures. These risk weights should be carefully calibrated such that the portfolios of banks and insurance corporations do not have excessive concentrations of non-senior SBBS. Second, mezzanine and junior SBBS could be subject to position limits, so that holdings of these securities may not exceed a fixed threshold. This threshold could be set such that banks' or insurance corporations' holdings of mezzanine and junior SBBS do not exceed the relative proportions of these securities (so that they would be prevented from over-allocating their portfolios to the riskier securities). Both approaches would discourage (and, in the case of the limit, prevent) excessive holdings of junior and mezzanine SBBS.

- **SBBS should be exempt from retention rules, which are otherwise common for securitisations.** This exemption should apply on two grounds: (i) there is no moral hazard in portfolio selection by SBBS arranger(s) given the predefined composition of SBBS; (ii) there is in any case an exemption from retention rules for securitised exposures guaranteed by central governments or other public bodies.

Other possible policy goals:

- **Non-EU countries' regulatory treatment of SBBS should be in line with the treatment granted in the EU** so as to provide consistent treatment for non-EU investors.

Foreseeable changes to existing legislation

In order to grant SBBS the regulatory treatment outlined above, some provisions in existing legislation would need to be modified and others assessed in greater depth to identify amendments that may be needed. For example, some of the provisions on credit risk or market risk in the CRR might need to be amended to ensure that holdings of senior SBBS are treated in the same way as other sovereign exposures, including in terms of capital requirements for credit risk and mitigation benefits for securities held as collateral. Similarly, rules on spread risk on securitisation positions in Solvency II (Delegated Regulation (EU) 2015/35) might need to be amended to allow the tailored treatment of SBBS. The inclusion of SBBS in the different classes provided for in the LCR requirement should also be considered. Finally, eligibility criteria, concentration limits and diversification requirements for undertakings for UCITS (Directive 2009/65/EC) may also need to be adapted. Other pieces of legislation, such as the Market Abuse Directive (Directive 2014/57/EU) and Regulation (Regulation (EU) 596/2014), the European Market Infrastructure Regulation (Regulation (EU) 648/2012), the Financial Collateral Directive (Directive 2002/47/EC) and the IORP II Directive (2016/2341/EU), do not seem to need modification, although this assessment may need to be revisited once all the features of SBBS have been defined.

5.5 Implications of the treatment of sovereign exposures

The Basel Committee on Banking Supervision initiated a review of the RTSE in 2015. Following extensive analysis, the Basel Committee published a discussion paper in December 2017 with the aim of soliciting views from interested stakeholders to inform the Committee's longer-term thinking on this issue (Basel Committee on Banking Supervision, 2017). Some potential policy ideas outlined in that discussion paper include positive risk weights for sovereign exposures to address credit or concentration risk. Nevertheless, the Committee has not reached a consensus at this stage on making any changes to the RTSE.

In the context of such discussions, this section assesses the implications of possible reform options on the capital requirements of banks and insurance corporations. It then infers the corresponding relative appeal of senior SBBS as a diversified and senior claim on sovereign bonds. This analysis has no bearing on the relative merits or demerits of modifying the RTSE, which should be discussed in other fora because of its broader dimensions.

5.5.1 Banks

The analysis compares the impact on capital requirements if existing sovereign exposures were replaced by senior SBBS under different regulatory regimes (without prejudice to ongoing discussions on RTSE).[85] In particular, four RTSE reform options for banks are considered:

- **Status quo –** the existing regulatory treatment.
- **Reform option 1 –** a flat risk weight of 2%.
- **Reform option 2 –** positive risk weights depending on credit ratings.
- **Reform option 3 –** differentiated positive risk weights that increase with the concentration of a bank's holdings of a single issuer. Under this option, a marginal risk weight add-on is used to mitigate concentration risk in accordance with a stepwise function.
- **Reform option 4 –** combining options 2 and 3.[86] Under this option, risk weights are used for both concentration and credit risk.

The analysis indicates that, if the RTSE were reformed, senior SBBS would be comparatively more attractive in a scenario in which the RTSE is sensitive to concentration or credit risk. A

[85] Most of the analysis is conducted assuming a full portfolio rebalancing – from current holdings to holdings of senior SBBS. This may underestimate the resulting capital impact, since banks may choose to hold more non-senior SBBS. It should be borne in mind, however, that the product regulation would be calibrated to ensure that banks' holdings of non-senior SBBS would be limited. Moreover, the analysis assumes that the value of banks' existing sovereign portfolios is not affected by the exchange, so that banks will be able to replace their portfolio with senior SBBS on a euro-for-euro basis. This assumption is made for the sake of simplicity, and it would be insightful to relax this assumption to quantify the implications of more realistic price effects.

[86] The calculation of the impact of actual holdings assumes that all sovereign exposures would be subject to the new standardised approach and that the IRB approach for sovereign exposures would be removed.

similar analysis conducted for insurance corporations shows that the regulatory environment would be more supportive of SBBS if insurance corporations' sovereign holdings were subject to charges for concentration risk. As such, an ample supply of SBBS would allow banks and insurance corporations to diversify their sovereign bond holdings, thereby mitigating the impact on capital requirements that would be caused by RTSE reform. Clearly, however, this finding does not provide sufficient justification for embarking on RTSE reform, which should be evaluated in other policy fora owing to its broader implications for sovereign bond markets.

The analysis considers three scenarios for banks' sovereign exposures under different regulatory treatments of SBBS and assesses them against the four reform options presented above.[87] It compares current holdings with three additional scenarios that assume that banks exchange their holdings for senior SBBS (analogous to a portfolio swap). These latter three scenarios differ regarding the regulatory treatment of SBBS.

- **Scenario 1 – status quo:** SBBS do not exist, and banks hold their existing sovereign bond portfolios. This is the benchmark against which alternatives (with SBBS) are measured.
- **Scenario 2 – current regulation:** Banks' SBBS holdings are treated according to current securitisation regulation (Articles 242-270 of the CRR) and receive a risk weight of 20% for credit risk.[88] The look-through approach would apply to the concentration risk charge. This means that the share of each sovereign in the SBBS (multiplied by the total holdings that are exchanged for SBBS) would be set against the bank's common equity tier one (CET1) capital to determine whether and in which concentration bucket the exposure to that sovereign would fall. In the case of partial substitution, this amount would have to be added to the remaining sovereign holdings of each sovereign.
- **Scenario 3 – new product regulation:** Under this hypothetical scenario, senior SBBS are assumed to be exempt from any concentration risk charges due to their diversified nature. Senior SBBS would be subject to the capital charge that is associated with their respective credit quality step if capital charges for credit risk in sovereign exposures were introduced. These provisions would be specified in an SBBS-specific product regulation.

Results

As an illustrative exercise, banks are assumed to exchange their entire portfolio of sovereign holdings for senior SBBS. The results are presented in Table 5.1, which contains several insights corresponding to the respective reform options.

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87 The analysis is based on EBA 2015 Transparency Exercise data for mid-2015 and includes 105 EU banks at the highest level of consolidation. Sovereign exposures are calculated on the basis of the credit risk template and include exposures to central governments, regional governments and local authorities. As a robustness check, the baseline calculations are repeated using only exposures to central governments. The composition of SBBS is assumed to include only euro area sovereign bonds. Further, it is assumed that senior SBBS obtain a rating within credit quality step 1.

88 Assuming that senior SBBS obtain a rating within credit quality step 1 (Article 251 of the CRR), the risk weight is 20%. If senior SBBS had no rating, and assuming that banks would make use of Article 253, the risk weight would be that of the underlying sovereign exposures, which without any changes to the status quo could be 0%.

Table 5.1

Bank capital requirements under RTSE reform options and scenarios for the treatment of senior SBBS

	Scenario 1 (current sovereign bond holdings; no SBBS)		Scenario 2 (SBBS under current regulation; credit risk weight on senior SBBS: 20%)		Scenario 3 (SBBS under new product regulation, credit risk weight on senior SBBS: 0-2%)	
	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital
Status quo	0	0	70.7	5.0	0	0
Reform option 1 (flat risk weight)	7.3	0.5	70.7	5.0	7.3	0.5
Reform option 2 (credit risk)	10.8	0.8	70.7	5.0	7.3	0.5
Reform option 3 (concentration risk)	37.6	2.7	76.9	5.5	0	0
Reform option 4 (concentration and credit risk)	48.3	3.4	76.9	5.5	7.3	0.5

Source: EBA and ESRB calculations.
Note: The table refers to the additional capital that banks would need to raise to keep their current CET1 capital ratio constant, both in billions of euro and as a percentage of CET1 capital. Calculations are based on data from 105 banks in the EBA transparency exercise (2015), and include exposures to central government, regional government and local authorities. In the first column, SBBS do not exist, and banks hold their current sovereign bond portfolios; in the second column, banks reinvest all of their sovereign bond portfolios into senior SBBS, which are subject to the current regulatory treatment with a credit risk weight of 20%; in the final column, banks' senior SBBS holdings are subject to a new regulatory treatment, with a risk weight that depends on the RTSE.

The status quo would lead to a higher cost for holding SBBS versus the underlying directly, given that senior SBBS would have a high credit risk weight of 20% under current regulation (Scenario 2). This is a key reason for the non-existence of SBBS. For reform option 1, the impact on capital requirements is identical for Scenarios 1 and 3. This result is driven by the assumption that a flat risk weight would apply to senior SBBS.[89]

Under reform option 2, the impact in Scenario 1 is slightly higher than in Scenario 3. This reflects the fact that the average risk weight of 3.1% for sovereign exposures in Scenario 1 is higher than the risk weight for senior SBBS of 2% in Scenario 3. This is driven by the assumption that senior SBBS would be assigned to the highest credit quality bucket.[90] The results for RTSE reform options 3 and 4 show the additional benefit for senior SBBS arising from the application of

[89] If senior SBBS were exempt from such a flat risk weight, the capital impact would be zero.

[90] If senior SBBS were assigned to a lower credit quality bucket, the capital impact would be correspondingly higher. By contrast, if they were exempt from such a credit risk weight, the capital impact would be zero.

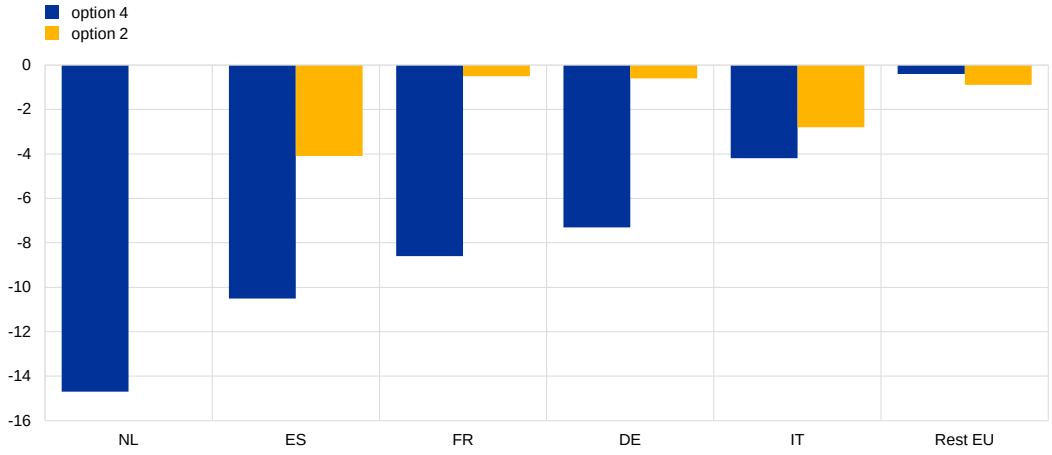
concentration risk charges. Under Scenario 3, SBBS would benefit from their built-in diversification and therefore would not receive any concentration risk charges by assumption.[91]

The results for the impact on capital requirements vary by Member State, as concentration levels and size of sovereign holdings differ markedly. Figure 5.1 shows the impact for the five Member States with the highest capital needs under reform option 4 for Scenario 3 in comparison to Scenario 1. The country-level results show that the possible future SBBS regulation would have less of an impact on capital requirements for some countries.

Figure 5.1

Differential impact by country on capital requirements for senior SBBS under Scenario 3 compared with Scenario 1

(in € billions)



Source: EBA and ESRB calculations.
Note: The figure shows capital requirements senior SBBS in Scenario 3 (when banks hold senior SBBS, which are treated under a new SBBS-specific product regulation) compared with Scenario 1 (when banks hold their current portfolios). For example, if Spanish banks were to switch their current sovereign bond portfolios for senior SBBS, their new holdings would be subject to capital requirements that are approximately €10 billion lower with an SBBS-specific product regulation when RTSE reform option 4 (i.e. capital requirements for sovereign exposures that are sensitive to credit and concentration risk) is considered. When RTSE reform option 2 (i.e. capital requirements for sovereign exposures that are sensitive to credit risk only) is considered, switching into senior SBBS would reduce capital requirements by €4 billion for Spanish banks. Qualitatively similar results obtain for the Netherlands, France, Germany and Italy.

The previous analysis assumed that banks substitute all of their sovereign exposures into senior SBBS under Scenarios 2 and 3. In practice, however, it is almost certain that banks would only partially substitute into senior SBBS. On this basis, Figure 5.2 plots the impact on capital requirements under RTSE option 3 (in the left-hand panel) and option 4 (in the right-hand panel). In both panels, a 0% substitution share on the horizontal axis corresponds to Scenario 1 (when banks do not hold any senior SBBS) and a 100% substitution share corresponds to Scenario 3 (with an SBBS-specific product regulation). To a first approximation, bank capital requirements are linearly

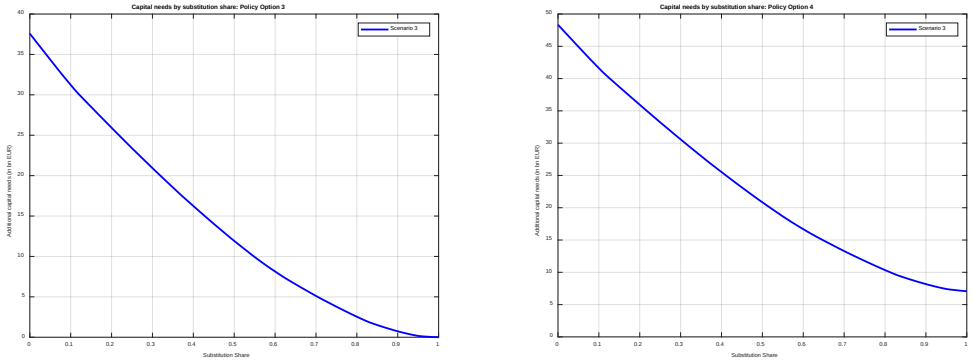
[91] If such an exemption were not applied to senior SBBS, so that the look-through approach would apply instead, the capital impact under reform option 3 would be €6.2 billion, while the capital impact under reform option 4 would be €13.5 billion.

decreasing in the substitution share for both RTSE reform options. Banks could therefore use senior SBBS to mitigate the impact on capital requirements resulting from RTSE reform.

Figure 5.2

Impact on capital requirements under RTSE reform option 3 (left-hand panel) and option 4 (right-hand panel) for varying substitution shares into senior SBBS

(in € billions)



Source: EBA and ESRB calculations.
Note: The figure plots additional bank capital requirements on the vertical axis (in € billions) against their fractional substitution from sovereign bonds into senior SBBS. The left-hand panel illustrates the case of RTSE reform option 3, in which the treatment of sovereign exposures is sensitive to concentration risk, and the right-hand panel shows RTSE reform option 4, in which the treatment is sensitive to both concentration and credit risk. The lines are downward-sloping in both panels, which indicates that senior SBBS could be used by banks to mitigate the impact of RTSE reform on their capital requirements.

Conclusion

Overall, the assessment confirms that the current regulatory treatment of SBBS would be unfavourable under all reform options, even for senior SBBS. This includes their capital treatment and their ineligibility for any liquid asset status under the LCR requirement. These insights provide motivation for a dedicated SBBS product regulation.

The findings also confirm that senior SBBS would be substantially more attractive to banks if the RTSE were changed to be more sensitive to concentration or credit risk, as banks could hold senior SBBS (rather than sovereign bonds directly) to partly mitigate the impact of any regulatory reform on capital requirements. The extent of such mitigation is a function of the size of the SBBS market and the treatment of senior SBBS as regards concentration risk.

SBBS under RTSE reform options

Scenario 1

Scenario 1 assumes that banks continue to hold their current sovereign holdings, which would be subject to the four options discussed for reforming RTSE, while SBBS do not exist.

Risk weights for sovereign exposures

Recalling the four options for reforming RTSE:[92]

Reform option 1: Flat risk weight for all sovereign holdings of 2%.

Reform option 2: Risk weight for sovereign exposures according to the credit risk function shown in Table 5.2.

Table 5.2
Illustrative calibration for risk weights based on credit risk (option 2)

Credit risk	Credit quality step 1 (AAA to AA-)	Credit quality step 2 (A+ to B-)	Credit quality step 3 (below B-)
Risk weight	2%	5%	10%

Source: ESRB calculations.
Note: The table reports an illustrative calibration for risk weights based on credit risk under RTSE reform option 2. This calibration is used to quantify the impact of such a regulatory regime on bank capital requirements with and without SBBS.

Credit ratings from the end of June 2015 are used to quantify the impact of reform option 2 on bank capital requirements. S&P ratings are reported in Table 5.3.

[92] To match the data for sovereign holdings, risk weights for each country are determined by using credit ratings assigned by S&P at the end of June 2015.

Table 5.3

Mapping of credit ratings to risk weights for euro area countries

Country	S&P rating as at end-June 2015	Risk weight as at end-June 2015
Austria	AA+	2%
Belgium	AA	2%
Cyprus	B+ (subsequently upgraded to BB+)	5%
Estonia	AA-	2%
Finland	AA+	2%
France	AA	2%
Germany	AAA	2%
Greece	CCC- (subsequently upgraded to B-)	10%
Ireland	A	5%
Italy	BBB- (subsequently upgraded to BBB)	5%
Latvia	A-	5%
Lithuania	A-	5%
Luxembourg	AAA	2%
Malta	BBB+ (subsequently upgraded to A-)	5%
Netherlands	AA+ (subsequently upgraded to AAA)	2%
Portugal	BB (subsequently upgraded to BBB-)	5%
Slovakia	A (subsequently upgraded to A+)	5%
Slovenia	A- (subsequently upgraded to A+)	5%
Spain	BBB (subsequently upgraded to BBB+)	5%

Source: S&P and ESRB calculations.
Note: The table reports S&P credit ratings as at end-June 2015 (to match the reference date for the EBA data on sovereign bond holdings). Since 2015, S&P has revised credit ratings for a number of countries, as indicated in parentheses in the table (as at the end of December 2017, which represents the cut-off date for data in this report).

Reform option 3: Marginal risk weight add-on to mitigate concentration risk according to the function shown in Table 5.4 (variant 2).

Table 5.4

Illustrative calibration for risk weights based on concentration risk (option 3, variant 2)

Thresholds (as % of CET1)	0-25	25-150	150-200	200-250	250-300	>300
Risk weight	0%	1%	2%	4.5%	7%	50%

Source: ESRB calculations.
Note: The table reports an illustrative calibration for risk weights based on concentration risk under RTSE reform option 3 (variant 2). This calibration is used to quantify the impact of such a regulatory regime on bank capital requirements with and without SBBS.

Reform option 4: Risk weights for both concentration and credit risk (combining options 2 and 3), as shown in Table 5.5.

Table 5.5

Illustrative calibration for risk weights based on concentration and credit risk (option 4)

Thresholds (as % of CET1)	AAA to AA-	A+ to B-	Below B-
0-25	2%	5%	10%
25-150	3%	6%	11%
150-200	4%	7%	12%
200-250	6.5%	9.5%	14.5%
250-300	9%	12%	17%
>300	52%	55%	60%

Source: ESRB calculations.
Note: The table reports an illustrative calibration for risk weights based on concentration and credit risk under RTSE reform option 4. This calibration is used to quantify the impact of such a regulatory regime on bank capital requirements with and without SBBS.

Data and assumptions used in the analysis

The data used for the impact analysis are subject to some caveats. First, the data from the credit risk template includes exposures to central banks. This analysis assumes that the changes in the RTSE would not apply to central bank exposures. As the credit risk template includes exposures to central banks, these should be deducted. This is done using Financial Reporting (FINREP) data. This procedure is subject to some caveats, however, so the central bank exposures that are deducted are only a proxy and should not be taken as the true underlying values.

The FINREP data are contained in the template "F20.04 – Geographical breakdown of assets by residence of the counterparty", complemented by data from templates F01.01 and various F04 sheets. The caveat is that the geographical breakdown is not available for all banks in the sample. Therefore, if only total central bank exposures are reported, assumptions have to be made on how to allocate them across the different counterparty countries. To do this, it is assumed that central bank exposures are allocated proportionally to the reported allocation of exposures to central governments or central banks. In addition, FINREP data only account for euro area countries and a subset of euro area banks. The euro area average of central bank exposures is therefore used for banks from EU countries and for euro area banks without FINREP data. Another caveat of the FINREP data is that they are based on accounting standards and do not fully correspond to the exposures reported in the credit risk template (based on regulatory reporting). For example, repo transactions with the central bank are not fully captured under FINREP.

Second, certain domestic sovereign exposures already receive a non-zero risk weight in the EBA dataset. This concerns exposures to which the discretion of applying a zero risk weight (such as deferred tax assets (DTAs), exposures denominated in non-EU currencies and exposures to regional and local governments that are not treated as equivalent in risk to central governments and IRB risk weights) does not apply. The regulatory treatment for some of these exposures would not necessarily change under the policy options (e.g. DTAs). Using the average implied risk weight would underestimate the impact, as shown in the next paragraph.

To show how using the average risk weight would underestimate the impact, consider the following example. Assume there are 100 sovereign exposures, of which 10 are denominated in a foreign currency and would receive a risk weight of 50%. This gives an implied risk weight of 5% for the entire sovereign exposure ([0*90+0.5*10]/100). If the amount of foreign currency-denominated sovereign exposure is not known and the average implied risk weight is used, introducing a flat risk weight of 5% implies no capital shortfalls. However, if the part that is denominated in foreign currency is known and can be treated separately, capital shortfalls would arise due to an increase in risk-weighted assets for the zero risk-weighted sovereign exposures denominated in domestic currency.

Exposures to central governments or central banks under the standardised approach: This exposure category can include sovereign exposures denominated in non-EU currencies, which need to be risk-weighted based on the credit quality of the sovereign, or DTAs, which are risk-weighted with either 100% or 250%. Where information on the amounts is available, these exposures have been excluded from the impact analysis. If this information is not available, a zero risk weight for all domestic sovereign exposures is assumed.

Exposures to regional governments or local authorities under the standardised approach: According to Article 115(2) of the CRR, these exposures receive a zero risk weight only if there is no difference in risk between such exposures and exposures to central governments. This is not the case for all EU Member States. Exposures in a number of EU Member States to regional governments and local authorities instead receive a 20% risk weight pursuant to Article 115(5) of the CRR. In the impact analysis, exposures to regional governments or local authorities receiving a zero risk weight are treated the same way as exposures to central governments. The current risk weight is used as the floor for those regional governments receiving a non-zero risk weight. In the latter case, this means capital shortfalls only arise if the risk weight applied under the policy option is higher than the current risk weight.

Exposures to central governments or central banks under the IRB: Domestic exposures to central governments do not necessarily receive a zero risk weight as the risk weight depends on the internal model. In the impact analysis, the implied risk weights for IRB exposures are used as a floor.

The data from the EBA's Transparency Exercise (2015) are based on common reporting (COREP). As such, they do not in all cases provide the geographical distribution of sovereign exposures in the required granularity. The implementing technical standard on Supervisory Reporting only requires the information on the geographical distribution of exposures by country of counterparty to be provided when total non-domestic exposures are equal to or greater than 10% of total exposures. Therefore, a simplifying assumption has to be taken. If no further information is available, it is assumed for significant institutions that 90% of the sovereign exposures are domestic and the rest are foreign, and for the less significant institutions that 100% of the sovereign exposures are domestic. Furthermore, if the geographical exposure is reported, it is only reported for the most important counterparty countries, such that either 95% of original exposures or the 10 largest countries are reported (see EBA Technical Guidance (2015), pp. 6-7). This affects the impact analysis for non-domestic exposures, as only the average implied risk weight can be used to calculate the impact.

Sensitivity analysis

As a first robustness check, the analysis turns to the capital charges for the case in which banks would also exchange part of their sovereign portfolio for mezzanine and junior SBBS, instead of only senior SBBS.[93] To facilitate comparison, it is again assumed that all sovereign holdings would be exchanged for SBBS, but that senior securities would now make up 70% of the SBBS portfolio, instead of 100%, while mezzanine securities would make up 20% and junior securities 10%. By construction, senior SBBS would bear less credit risk than non-senior SBBS, so the credit risk weights for mezzanine and junior SBBS would be higher. The assumed risk weights for non-senior SBBS are shown in Table 5.6 on the premise that mezzanine SBBS would have a rating between BBB+ and BBB- and that junior SBBS would be unrated. The analysis of risk

[93] This assumption is used only for reference. For financial stability purposes it may make sense to calibrate risk charges to ensure that banks do not hold substantial amounts of non-senior SBBS.

weights for mezzanine and junior SBBS indicates that the high risk weights would make it unattractive for banks to hold these securities.

Table 5.6

Indicative risk weights for mezzanine and junior SBBS (under Scenarios 2 and 3)

	Scenario 2 SBBS holdings subject to securitisation regulation (CCR, Articles 242-270)		Scenario 3 SBBS holdings subject to possible future product regulation	
	Risk weight for mezzanine SBBS (rating: BBB+ to BBB-)	Risk weight for junior SBBS (unrated)	Risk weight for mezzanine SBBS (rating: BBB+ to BBB-)	Risk weight for junior SBBS (unrated)
Reform option 1	100%[1]	1250%[2]	50%	100%
Reform option 2	100%	1250%	50%	100%
Reform option 3	100%	1250%	0%	0%
Reform option 4	100%	1250%	50%	100%

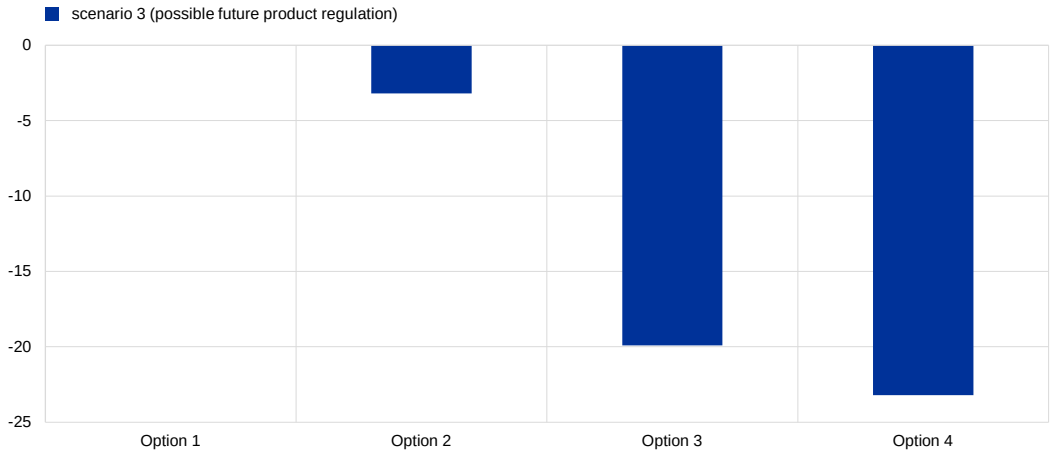
Source: ESRB calculations.
Note: The table reports illustrative risk weights that could be assigned to mezzanine and junior SBBS. This calibration is used to quantify the impact of such risk weights on bank capital requirements if banks were to hold non-senior SBBS.
1) The same risk weight is assumed to apply for mezzanine SBBS under all reform options (assuming a credit rating between BBB+ and BBB-). See Article 251 of the CRR (Table 1).
2) The risk weight might be lower if Article 253 of the CRR is applied, but not lower than the risk weight of the mezzanine tranche.

As a second sensitivity analysis, it is assumed that senior SBBS would replace only central government exposures on the rationale that only these securities are eligible for inclusion in the portfolio underlying SBBS. This reduces the exposure and, therefore, the regulatory capital required to fund those exposures. Thus, this estimation gives qualitatively similar results, but quantitatively the capital impact is lower, as shown in Figure 5.3 and Table 5.7. For the first two options, considering only credit risk, the difference to the baseline case (which includes exposures to regional and local governments) is around €2-3 billion, whereas for options 3 and 4 the difference is larger, since exposures to regional and local governments are disproportionately concentrated.

Figure 5.3

Reduction in capital requirements by holding senior SBBS rather than central governments

(in € billions)



Source: EBA and ESRB calculations.
Note: The figure shows the reduction in total capital requirements if banks were to substitute their central government exposures into senior SBBS. The reductions are lower than in Table 5.1 owing to the exclusion of regional and local governments.

Table 5.7

Bank capital requirements under RTSE reform options and scenarios for the treatment of senior SBBS (using only exposures to central governments)

	Scenario 1 (current central government bond holdings; no SBBS)		Scenario 2 (SBBS under current regulation; credit risk weight on senior SBBS: 20%)		Scenario 3 (SBBS under new product regulation, credit risk weight on senior SBBS: 0-2%)	
	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital
Reform option 1 (flat risk weight)	5.2	0.4%	52.2	3.7%	5.2	0.4%
Reform option 2 (credit risk)	8.4	0.6%	52.2	3.7%	5.2	0.4%
Reform option 3 (concentration risk)	19.9	1.4%	54.3	3.9%	0	0%
Reform option 4 (concentration and credit risk)	28.4	2.0%	54.3	3.9%	5.2	0.4%

Source: EBA and ESRB calculations.
Note: The table reports the additional capital that banks would need to raise to keep their current CET1 capital ratio constant, both in billions of euro and as a percentage of CET1 capital. Calculations are based on data from 105 banks in the EBA transparency exercise (2015), and include only exposures to central government (in contrast with Table 5.1, which also includes exposures to regional and local government). In the first column, SBBS do not exist, and banks hold their current sovereign bond portfolios; in the second column, banks reinvest all of their sovereign bond portfolios into senior SBBS, which are subject to the current regulatory treatment with a credit risk weight of 20%; in the final column, banks' senior SBBS holdings are subject to a new regulatory treatment, with a risk weight that depends on the RTSE.

The results when banks hold a portfolio consisting of senior, mezzanine and junior SBBS indicate that the regulatory treatment for the two non-senior SBBS would deter banks from holding them. With the exception of option 3 (where only concentration risk charges apply), the impact is higher than when banks hold only sovereign exposures (see Table 5.8). The stronger impact comes exclusively from the impact of mezzanine and junior securities, as Figure 5.4 shows.

Table 5.8

Bank capital requirements under RTSE reform options and scenarios for the treatment of SBBS (assuming substitution into a replicating SBBS portfolio)

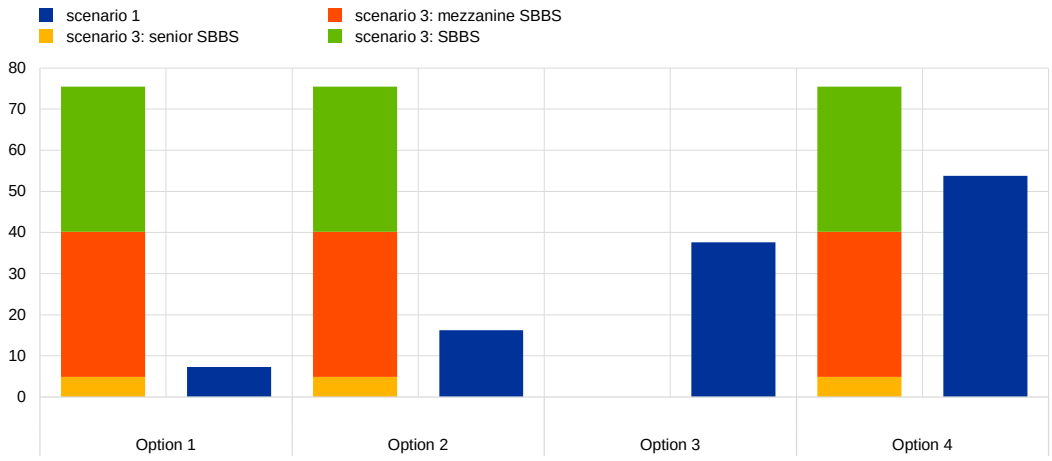
	Scenario 1 (current sovereign bond holdings; no SBBS)		Scenario 2 (SBBS under current regulation; see Table 5.6 for risk weights)		Scenario 3 (SBBS under new product regulation; see Table 5.6 for risk weights)	
	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital
Reform option 1 (flat risk weight)	7.3	0.5%	561.8	40.0%	75.6	5.4%
Reform option 2 (credit risk)	10.8	0.8%	561.8	40.0%	75.6	5.4%
Reform option 3 (concentration risk)	37.6	2.7%	568.0	40.4%	0	0%
Reform option 4 (concentration and credit risk)	48.3	3.4%	568.0	40.4%	75.6	5.4%

Source: EBA and ESRB calculations.
Note: The table refers to the additional capital that banks would need to raise to keep their current CET1 capital ratio constant, both in billions of euro and as a percentage of CET1 capital. Calculations are based on data from 105 banks in the EBA transparency exercise (2015), and include exposures to central government, regional government and local authorities. In the first column, SBBS do not exist, and banks hold their current sovereign bond portfolios; in the second column, banks reinvest all of their sovereign bond portfolios into a replicating portfolio of senior, mezzanine and junior SBBS, where senior SBBS are subject to current regulatory treatment with a credit risk weight of 20%, and mezzanine and junior SBBS are subject to the regulatory treatment defined in Table 5.6; in the final column, banks' senior SBBS holdings are subject to a new regulatory treatment, with a risk weight that depends on the RTSE.

Figure 5.4

Increase in capital requirements by holding a replicating SBBS portfolio rather than sovereign exposures

(in € billions)



Source: ESRB calculations
Note: The figure shows the increase in capital requirements that banks would incur if they were to switch their current sovereign exposures into a replicating SBBS portfolio. Under all RTSE reform options 1, 2 and 4, a replicating SBBS portfolio would incur an increase in capital requirements of €75.6 billion, the vast majority of which would arise from banks' holdings of mezzanine and junior SBBS. Under RTSE reform option 3, however, the replicating SBBS portfolio is assumed to be subject to a "look-through" approach, and therefore exempt from capital charges based on credit risk, whereas banks' current sovereign exposures would incur an increase in capital requirements of €37.6 billion.

A more severe calibration for concentration risk charges – for example variant 1 for reform option 3 (see Table 5.9) – produces a stronger capital impact for Scenarios 1 and 2 (as shown in Table 5.10). This highlights that the benefit of SBBS following the application of concentration risk charges increases with the severity of concentration risk charges.

Table 5.9

Illustrative calibration for risk weights based on concentration risk (option 3, variant 1)

Thresholds (as % of CET1)	0-100	100-150	150-200	200-250	250-300	>300
Risk weight	2%	7%	9.5%	12%	14.5%	50%

Source: ESRB calculations.
Note: The table reports an illustrative calibration for risk weights based on concentration risk under RTSE reform option 3 (variant 1). This calibration is used to quantify the impact of such a regulatory regime on bank capital requirements with and without SBBS.

Table 5.10

Bank capital requirements under RTSE reform options and scenarios for the treatment of senior SBBS (with a stricter calibration for concentration risk as given in Table 5.9)

	Scenario 1 (sovereign bond holdings; no SBBS)		Scenario 2 (SBBS under current regulation; credit risk weight on senior SBBS: 20%)		Scenario 3 (SBBS under new product regulation, credit risk weight on senior SBBS: 0-2%)	
	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital	€ billions	As % of CET1 capital
Reform option 1 (flat risk weight)	7.3	0.5%	70.7	5.0%	7.3	0.5%
Reform option 2 (credit risk)	10.8	0.8%	70.7	5.0%	7.3	0.5%
Reform option 3 (concentration risk)	47.4	3.4%	84	6%	0	0%
Reform option 4 (concentration and credit risk)	58.1	4.1%	84	6%	7.3	0.5%

Source: EBA and ESRB calculations.
Note: The table refers to the additional capital that banks would need to raise to keep their current CET1 capital ratio constant, both in billions of euro and as a percentage of CET1 capital. Calculations are based on data from 105 banks in the EBA transparency exercise (2015), and include exposures to central government, regional government and local authorities. In the first column, SBBS do not exist, and banks hold their current sovereign bond portfolios; in the second column, banks reinvest all of their sovereign bond portfolios into senior SBBS, which are subject to the current regulatory treatment with a credit risk weight of 20%; in the final column, banks' senior SBBS holdings are subject to a new regulatory treatment, with a risk weight that depends on the RTSE. Compared to the results shown in Table 5.1, only the capital impact for options 3 and 4 under Scenarios 1 and 2 change owing to the stricter calibration for concentration risk given in Table 5.9.

5.5.2 Insurance corporations

A similar analysis has been conducted on the implications for insurance corporations replacing their sovereign holdings with senior SBBS. Table 5.11 shows estimates of the absolute and relative increase in the SCR for euro area solo insurance corporations if they were to reinvest their current holdings of euro-denominated sovereign bonds, which in the table are assumed to be treated under the current regulatory framework, into senior SBBS. In addition to the current regulatory treatment of SBBS, Table 5.11 shows the impact of three possible alternative SBBS treatments in a new product regulation (under the assumption that SBBS are not subject to market risk concentration charges).

In addition, reform of the RTSE for insurance corporations would affect the relative appeal of senior SBBS. If they were subject to capital charges for concentration and/or spread risk in their sovereign exposures, insurers would have an incentive to rebalance their portfolios to senior SBBS. For concentration risk, one conceivable approach would be to treat EEA sovereign bonds in the same way as local currency non-EEA sovereign bonds.[94] Under this approach, the capital charge

[94] See Article 187(4) of Commission Delegated Regulation 2015/35.

would also depend on the credit rating of the exposure. Consequently, the additional concentration risk charge would in many cases be near zero. Nevertheless, in some cases, the SCR increase would be meaningful; on aggregate, the increase in the SCR for euro area insurers would be approximately €23 billion, which represents an increase of 6.2%.[95] Insurance corporations that would be affected by such an SCR increase could use senior SBBS to mitigate the additional charge (if senior SBBS were regulated in line with Scenario 3 in Table 5.11).

Table 5.11

Increase in SCR requirements for euro area solo insurance corporations

	Status quo: Treatment of senior SBBS as type 2 securitisation	Scenario 1: Treatment of senior SBBS as type 1 securitisation	Scenario 2: Treatment of senior SBBS akin to corporate bonds	Scenario 3: Treatment of senior SBBS akin to sovereign bonds
Increase in SCR (in € billions)	963	166	54	0
Increase in SCR (in %)	262	45	14	0

Source: ESRB calculations.
Note: The table reports the increase in SCR requirements, both in billions of euro and in percent of SCR, for euro area solo insurance companies under different scenarios for the regulatory treatment of SBBS.

Data and underlying assumptions

This section includes some further details on the analysis of a shift from euro area sovereign bonds into senior SBBS. It looks at the implications for their regulatory capital requirements and the impact of including Member States' sovereign bonds in the existing market risk concentration sub-module.

Dataset

- The amount of investments by euro area insurers in euro area sovereign bonds is based on ECB data.
- The size of assets held by insurers in different euro area countries is based on ECB data.
- The effects of diversification and the loss absorbency of technical provisions and deferred taxes are estimated based on the correlations in the Solvency II legal framework and QIS5 data.[96]
- The ratio between SCR and assets is calculated on the basis of data from the European Insurance and Occupational Pensions Authority (EIOPA) report on the fifth quantitative impact study for Solvency II (2016).[97]

[95] Similar results in terms of the dispersion of risk charges across countries can be observed if the risk weights are determined in accordance with Article 186(1) of Commission Delegated Regulation 2015/35.

[96] **https://eiopa.europa.eu/Publications/Reports/QIS5_Report_Final.pdf**

- The allocation of insurers in individual euro area Member States to the sovereign bonds of euro area countries as a percentage of total assets is calculated on the basis of data published by EIOPA on the representative portfolios for the calculation of the volatility adjustments.[98]

Assumptions

- All euro area insurers make a complete shift from direct holdings of euro area central government bonds ("euro sovereign bonds") to senior SBBS. The remaining investment portfolio remains unchanged.
- Euro area insurers hold assets of €7.3 trillion.
- The current allocation of all euro area insurers to euro sovereign bonds is €1.5 trillion.
- The average duration is 8.96 years.[99] [100]
- The average duration of senior SBBS is equal to the average duration of euro sovereign bonds.
- The cash flow profiles of senior SBBS and euro sovereign bonds are equal.[101]
- SBBS are not backing unit-linked business.[102]
- Senior SBBS have a credit quality step of 0 (which normally corresponds to a credit rating of AAA).
- The regulatory capital requirements for senior SBBS and euro sovereign bonds are similar for insurers using the standard formula and internal models.
- The aggregate increase in the SCR for all euro area insurers can be approximated using the diversification effect and the loss-absorbing effect of technical provisions and deferred taxes.
- The ratio between the Basic Solvency Capital Requirement and the SCR (essentially the loss-absorbing capacity of deferred taxes and technical provisions) remains constant.
- The ratio between the SCR and assets for the average European insurer is 5%.

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97 **https://eiopa.europa.eu/Publications/Responses/EIOPA-BoS-16-279_LTG_REPORT_2016.pdf**

98 See **https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii-technical-information/risk-free-interest-rate-term-structures**

99 Modified duration is needed for the calculations in the spread risk sub-module. At current low yields, there should be no substantial difference between duration and modified duration.

100 In the case of securitisations, the use of an average modified duration does not introduce an element of error as the spread risk charge for securitisations is linearly dependent on the modified duration (in contrast to the concave dependency for corporate bonds).

101 This means that the capital requirement for interest rate risk does not change.

102 The effect would be smaller if euro sovereign bonds backed unit-linked business, as the risk is borne by the policyholder. In most cases, unit-linked business is backed by assets other than sovereign bonds (e.g. stocks).

5.6 Drivers of demand for SBBS relative to sovereign bonds under broader regulatory reforms

This section explores several sources of potential advantage from investing in SBBS relative to investing in a portfolio of underlying government bonds taking RTSE reform options into account. While the content of this section is subject to considerable uncertainty, it provides a useful basis for understanding the relative appeal of SBBS in different regulatory regimes.

5.6.1 Basel discussions on concentration risk

The Basel Committee initiated a review of the regulatory treatment of sovereign risk in 2015. This review is being conducted in a careful, holistic and gradual manner. Some of the potential policy options under consideration include the possibility of applying positive risk weights to all sovereign holdings to address credit risk and/or concentration risk in Pillar 1 (see Basel Committee on Banking Supervision, 2017). If one of these options were adopted, the question would arise as to how to apply the new treatment to SBBS.

With regard to credit risk, it would be possible to apply to senior SBBS the same treatment provided by the new framework to sovereign exposures with the same rating. The senior security may enjoy preferential treatment if it were issued by an entity that is exempted from positive risk weights. While existing bonds of supranational entities such as the ESM and EFSF are expected to be treated like exposures to the domestic sovereign (and therefore not fully exempted from regulatory requirements), special treatment for a private entity issuing SBBS seems unlikely. With regard to concentration risk, senior SBBS embed an element of diversification which would need to be captured by the new framework. A first possibility would be to consider SBBS separately from the underlying sovereign issuances for the purposes of any concentration threshold. A second possibility would be to adopt a look-through approach, with each bank having to add a pro rata amount to its sovereign exposures to reflect its indirect holdings via SBBS. A third approach would be to reward the diversification element by exempting SBBS from any concentration threshold.

There have also been discussions about the current treatment of sovereign exposures in insurance regulation. As for banks, introducing a risk charge for concentrations of sovereign exposures would make SBBS more attractive on a relative basis.

5.6.2 Implications of IFRS9

This section considers the accounting treatment of SBBS from the perspective of the holder. The classification and measurement of financial assets under IFRS 9 depend on a combination of the (i) business model under which the instrument is held and (ii) contractual characteristics of the instrument, i.e. whether they meet the "solely principal and interest on the principal amount" (SPPI) criteria and are classified in one of three measurement categories: (i) amortised cost (AC), (ii) FVTPL, and (iii) fair value through other comprehensive income (FVOCI). In addition, the FVO can be applied under certain conditions, leading to FVTPL classification (see paragraphs 4.1.1 to

4.1.5 of IFRS 9). The resulting classification of financial assets (the analysis here is limited to debt instruments) is determined using Table 5.12:

Table 5.12
Classification of financial assets by business model under IFRS 9

Business model	SPPI	Non-SPPI
Hold to collect	AC or FVTPL (if applied)	FVTPL
Hold to sell	FVTPL	FVTPL
Hold to collect and sell	FVOCI or FVTPL2	FVTPL

Source: ESRB.
Note: The table reports the classification of financial assets by business model under IFRS 9.

While plan vanilla (government) bonds meet the SPPI criteria, IFRS 9 includes specific criteria to assess whether contractually linked instruments (tranches) meet the SPPI test. To fulfil the SPPI criteria:

- the cash flow characteristics of the tranche must fulfil the SPPI criteria;
- the cash flow characteristics of the underlying instruments must fulfil the SPPI criteria (however, the underlying portfolio could include certain instruments that reduce the cash flow variability of the instruments held in the underlying portfolio or align the cash flows of the tranches with the cash flows of the pool of underlying instruments in terms of interest rate, currency or timing of the cash flows);
- the tranche must have an exposure to credit risk equal or lower to the average credit losses of the underlying pool (IFRS 9 B1.4.21).

Considerations for the classification and measurement of sovereign bonds

Sovereign bonds typically meet the SPPI criteria as they do not usually include specific complex features. Consequently, the classification and measurement of these bonds is driven by the business model under which these bonds are held (or application of the FVO). According to an overview of government bond holdings as at 31 December 2015 for the three largest euro area countries, approximately 19% of sovereign bond portfolios were measured at FVTPL (HFT), 66% were measured as FVOCI (held in AfS portfolios) and 15% were carried at amortised cost. Although the implementation of IFRS 9 will change these proportions and align them to business models, these numbers indicate a degree of diversity in sovereign bond holdings (reflecting different purposes for which these bonds are held). EBA impact assessments indicate that most banks do not expect the application of the prudential requirements on liquidity to affect the classification of their assets under IFRS 9 (as that will be driven by business models).

Senior SBBS would be classified according to the business model, while junior SBBS would need to be mandatorily measured at FVTPL as that security would embed a credit risk exposure that is higher than the average exposure of the underlying pool, thus failing the SPPI criteria. This

compares with a situation where a non-negligible amount of sovereign bonds is currently held in portfolios that are measured at either AC or FVOCI. For mezzanine SBBS, a probability-weighted analysis of credit events would need to be conducted to assess their credit risk and ascertain whether they meet the SPPI criteria and qualify for AC or FVOCI treatment.

Additional considerations

The following issues would need to be settled, depending on the final design of SBBS and the operational steps leading to the development of an SBBS market (notably if the issuing entity acquires the underlying bonds from credit institutions holding SBBS):

1. **If the issuing entity is independent from the credit institution holding the original bonds:**

   (a) whether the sale of sovereign bonds modifies the business model of the credit institution defined in IFRS 9. This depends on the existing business model under which these bonds are held. These financial assets might need to be reclassified if the business model changes.

   (b) assessment of the business model for sovereign bonds bought by credit institutions on the primary market with the intention of selling them to the issuing entity (as this is an example of a hold-to-sell business model, bonds purchased to be securitised will be measured at FVTPL).

2. **If the issuing entity is related to the credit institution holding the original bonds** (e.g. its subsidiary), an assessment is required as to whether the issuing entity should be consolidated as it is controlled by the credit institution, which will be more likely if junior SBBS are retained by the credit institution. If the issuing entity were to be consolidated, the original bonds would be recorded as being on the balance sheet.

3. **Whether the original sovereign bonds which are sold from the portfolios of credit institutions to (un)consolidated issuing entities meet the de-recognition criteria,** which are based on the transfer of substantially all risks and rewards of ownership.

References

Acharya, V. V., R. Engle and M. Richardson (2012). “Capital shortfall: a new approach to ranking and regulating systemic risks.” American Economic Review, 102(3): 59-64.

Acharya, V. V., L. H. Pedersen, T. Philippon and M. Richardson (2017). “Measuring systemic risk.” Review of Financial Studies, 30(1): 2-47.

Adrian, T. and M.K. Brunnermeier (2016). “Co-VaR.” American Economic Review, 106(7): 1705-1741.

Amihud, Y. and H. Mendelson (1980). “Dealership market: market making with inventory.” Journal of Financial Economics, 8: 31-53.

Amihud, Y. (2002). “Illiquidity and stock returns: cross-section and time series effects.” Journal of Financial Markets, 5: 31-56.

Baranova, Y., Z. Liu and J. Noss (2016). “The role of collateral in supporting liquidity.” Bank of England working paper no. 609.

Baranova, Y., Z. Liu and T. Shakir (2017). “Dealer intermediation, market liquidity and the impact of regulatory reform.” Bank of England working paper no. 665.

Basel Committee on Banking Supervision (2017). “The regulatory treatment of sovereign exposures – a discussion paper.”

Bénassy-Quéré, A., M.K. Brunnermeier, H. Enderlein, E. Farhi, M. Fratzcher, C. Fuest, P. Gourinchas, P. Martin, J. Pisani-Ferry, H. Rey, I. Schnabel, N. Véron, B. Weder di Mauro and J. Zettelmeyer (2018). “Reconciling risk sharing with market discipline: a constructive approach to euro area reform.” Centre for Economic Policy Research Policy Insight no. 91.

Bessler, W., A. Leonhardt and D. Wolf (2016). “Analyzing hedging strategies for fixed income portfolios: a Bayesian approach for model selection.” International Review of Financial Analysis, 46(C): 239-256.

Bofinger, P., L. Feld, C. Schmidt, I. Schnabel and V. Wieland (2017). “Towards a forward-looking economic policy.” German Council of Economic Experts Annual Report.

Brownlees, C.T. and Engle, R. (2017). “SRISK: a conditional capital shortfall measure of systemic risk.” Review of Financial Studies, 30(1): 48-79. Previously published as ESRB working paper no. 37.

Brunnermeier, M.K., L. Garicano, P. Lane, M. Pagano, R. Reis, T. Santos, D. Thesmar, S. Van Nieuwerburgh and D. Vayanos (2011). “European Safe Bonds (ESBies).” The Euronomics Group.

Brunnermeier, M.K., L. Garicano, P. Lane, M. Pagano, R. Reis, T. Santos, D. Thesmar, S. Van Nieuwerburgh and D. Vayanos (2016). “The sovereign-bank diabolic loop and ESBies.” American Economic Review Papers and Proceedings, 106(5): 508-512.

Brunnermeier, M.K., S. Langfield, M. Pagano, R. Reis, R., S. Van Nieuwerburgh and D. Vayanos (2017). “ESBies: safety in the tranches.” Economic Policy, 32(90): 175-219. Previously published as ESRB working paper no. 21.

Bufano, M., S. Fabiole-Nicoletto and M. Manna (2018). “Would they do it anyway? Treasury’s monetary incentives to primary dealers.” Mimeo.

Chen, S.S., C. Lee and K. Shrestha (2003). “Futures hedge ratios: a review.” Quarterly Review of Economics and Finance. 43: 433-465.

Committee on the Global Financial System (2014). “Market-making and proprietary trading: industry trends, drivers and policy implications.”

Conefrey, T. and D. Cronin (2015). “Spillover in euro area sovereign bond markets.” Economic and Social Review, 46(2): 197-231.

Copeland, T.C. and D. Galai (1983). “Information effects on the bid-ask spread.” Journal of Finance, 38: 1457-1469.

Corsetti, G., L. Feld, P. Lane, L. Reichlin, H. Rey, D. Vayanos and B. Weder di Mauro (2015). “A new start for the Eurozone: dealing with debt.” Monitoring the Eurozone 1, CEPR Press.

Corsetti, G., L. Feld, R. Koijen, L. Reichlin, R. Reis, H. Rey and B. Weder di Mauro (2016). “Reinforcing the Eurozone and protecting an open society.” Monitoring the Eurozone 2, CEPR Press.

Credit Agricole (2017). “Considerations on sovereign bond-backed securities (SBS)”. Mimeo.

Cronin, D. and P.G. Dunne (2018). “How effective are euro area sovereign bond-backed securities as a spillover prevention device?” ESRB working paper no. 66.

Cruces, J. and C. Trebesch (2013). “Sovereign defaults: the price of haircuts.” American Economic Journal: Macroeconomics, 5(3): 85-117.

De Sola Perea, M., P.G. Dunne, M. Puhl and T. Reininger (2018). “Sovereign bond-backed securities: a VAR-for-VaR and Marginal Expected Shortfall assessment.” ESRB working paper no. 65.

Demary, M. and J. Matthes (2017). “An evaluation of sovereign-backed securities.” Cologne Institute for Economic Research IW policy paper 12/2017.

Demsetz, H. (1968). “The cost of transacting.” Quarterly Journal of Economics 82(1): 33-53.

Diebold, F.X. and K. Yilmaz (2012). “Better to give than to receive: predictive directional measurement of volatility spillovers.” International Journal of Forecasting, 28(1): 57-66.

Dunne, P.G. (2018). “Positive liquidity spillovers from sovereign bond-backed securities.” ESRB working paper no. 67.

Dunne, P.G., M.J. Moore and R. Portes (2007). “Benchmark status in fixed income asset markets.” Journal of Business, Finance and Accounting, 34(9-10): 1615-1634.

DZ Bank (2017). “ESBies – neues Mega-Segment oder Structured Finance Fata Morgana.” Asset Backed Watcher.

Easley, D. and M. O'Hara (1987). “Price, trade size, and information in securities markets.” Journal of Financial Economics, 19: 69-90.

Engle, R. and S. Manganelli (2004). “CAViaR: conditional autoregressive value at risk by regression quantiles.” Journal of Business and Economic Statistics, 22(4): 367-381.

ESRB (2015). “ESRB report on the regulatory treatment of sovereign exposures.”

ESRB High-Level Task Force on Safe Assets (2018). “Sovereign bond-backed securities: a feasibility study.” Volume I.

Froot, K. and J. Stein (1998). “Risk management, capital budgeting and capital structure policy for financial institutions: an integrated approach.” Journal of Financial Economics, 47: 55-82.

Gao, P., P. Schultz and Z. Song (2017). “Liquidity in a market for unique assets: specified pool and to-be-announced trading in the mortgage-backed securities market.” Journal of Finance, 72(3): 1119-1170.

Garicano, L. and L. Reichlin (2014). “A safe asset for Eurozone QE: a proposal.” Vox-EU.

Gelpern, A. (2014). “A sensible step to mitigate sovereign bond dysfunction.” Peterson Institute for International Economics.

Glosten, L.R. and P.R. Milgrom (1985). “Bid, ask and transaction prices in a specialist market with heterogeneously informed traders.” Journal of Financial Economics, 14: 71-100.

Goldman Sachs (2017). “European Economics Daily: Eurobonds redux.” Economic Research report.

Hagströmer, B., R. Henricsson and L.L. Norden (2016). “Components of the bid-ask spread and variance: a unified approach.” Journal of Futures Markets, 36(6): 545-563.

Ho, T. and H.R. Stoll (1981). “Optimal dealer pricing under transactions and return uncertainty.” Journal of Financial Economics, 9: 47-73.

Ho, T. and H. Stoll (1983). “The dynamics of dealer markets under competition.” Journal of Finance, 4(38): 1053-1074.

Huang, R.D. and H.R. Stoll (1997). "The components of the bid-ask spread: a general approach." Review of Financial Studies, 10(4): 995-1034.

JPMorgan (2017). “European Safe Bonds.” Global Fixed Income Strategy research report.

Koenker, R. and G. Basset (1978). “Regression quantiles.” Econometrica, 46(1): 33-50.

Koop, G., M. Pesaran and S. Potter (1996). “Impulse response analysis in non-linear multivariate models.” Journal of Econometrics, 74: 119-147.

Koutmos, G. and A. Pericli (2000). “Are multiple hedging instruments better than one?” Journal of Porfolio Management. 26(2): 63-70.

Kraemer, M. (2017). “How S&P Global Ratings would assess European ‘Safe’ Bonds (ESBies).” S&P RatingsDirect.

Leandro, Á. and J. Zettelmeyer (2018). “Evaluating proposals for a euro area safe asset.” Working paper, Peterson Institute for International Economics.

Lien, D. and Y.K. Tse (2011). “Some recent developments in futures hedging.” Journal of Economic Surveys. 16(3): 359-396.

Lucas, A., B. Schwaab and X. Zhang (2017). “Modelling financial sector tail risk in the euro area.” Journal of Applied Econometrics, 32: 171-191.

Marcus, A.J. and E. Ors (1996). “Hedging corporate bond portfolios across the business cycle.” Journal of Fixed Income, 4(4): 56-60.

Morgan, L. (2008). “Combination hedges applied to US markets.” Financial Analysts Journal, 64: 74-84.

Naik, N. and Yadav, P. (2003). “Risk management with derivatives by dealers and market quality in government bond markets.” Journal of Finance, 58(5): 1873-1904.

Office of Financial Research (2015). Financial Stability Report.

Scaillet, O. (2005). “Nonparametric estimation of conditional expected shortfall.” Insurance and Risk Journal, 74: 639-660.

Schlepper, K., Hofer, H., Riordan, R. and Schrimpf, A. (2017). “Scarcity effects of QE: a transaction-level analysis in the Bund market.” Deutsche Bundesbank Discussion Paper no. 06/2017.

Schneider, M., F. Lillo and L. Pelizzon (2016). “How has sovereign bond market liquidity changed? An illiquidity spillover analysis.” SAFE working paper no. 151.

Schneider, Y.M. and S. Steffen (2017). “Feasibility check: transition to a new regime for bank sovereign exposure?” Provided at the request of the European Parliament’s Economic and Monetary Affairs Committee.

Schönbucher, P. J. (2003). Credit Derivatives Pricing Models: Models, Pricing and Implementation. London: Wiley.

Scientific Advisory Council to the German Federal Ministry of Finance (2017). “Treating the causes of the sovereign-bank nexus.” Letter from the Federal Ministry of Finance’s Advisory Board to the Federal Minister of Finance Dr Wolfgang Schäuble.

Sharpe, W. F. (1966). “Mutual fund performance.” Journal of Business, 39: 119-138.

Sharpe, W. F. (1994). “The Sharpe ratio.” Journal of Portfolio Management, 21: 49-58.

Shirvani, H. and B. Wilbratte (2005). “Duration and bond price volatility: some further results.” Journal of Economics and Finance Education, 4(1): 1-6.

Silverman, B. W. (1986). Density Estimation for Statistics and Data Analysis. London: Chapman and Hall.

Stoll, H. R. (1978). “The pricing of security dealer services: an empirical study of Nasdaq stocks.” Journal of Finance, 33(4): 1153-1172.

Sturzenegger, F. and J. Zettelmeyer (2008). “Haircuts: estimating investor losses in sovereign debt restructurings, 1998-2005.” Journal of International Money and Finance, 27(5): 780-805.

Tinic, S.M. and R.R. West (1972). “The cost of transacting.” Journal of Financial and Quantitative Analysis, 7(3): 1707-1727.

Tran, M.-N., D.J. Nott and C. Leng (2012). “The predictive Lasso.” Statistics and Computing, 22(5): 1069-1084.

Van Riet, A. (2017). “Addressing the safety trilemma: a safe sovereign asset for the eurozone.” ESRB working paper no. 35.

Vasil, R. (2018). “European safe asset: review of selected proposals from the perspective of a small and open economy.” Permanent Representation of the Slovak Republic to the EU.

Wendorff, K. and Mahle, A. (2015). “Staatsanleihen neu ausgestalten – für eine stabilitätsorientierte Währungsunion.” Wirtschaftsdienst, 95(9): 604-608.

White, H., T.-H. Kim and S. Manganelli (2015). “VAR for VaR: Measuring tail dependence using multivariate regression quantiles.” Journal of Econometrics, 187(1): 169-188.

Yuan, K. (2005). “The liquidity service of benchmark securities.” Journal of the European Economic Association, 3: 1156-1180.

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