FIXED INCOME

02/05/2016

Solvency II Capital Requirements for Debt Instruments

Impact of Solvency II on the Debt Markets

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This document is not intended to be an exhaustive review of the impact of Solvency II on the debt markets or the calculation of the Solvency Capital Requirement (SCR) under the standard formula. However, it is intended to provide a detailed description of the key elements in the calculation of the SCR for debt instruments. The variety of asset classes and risk types that constitute debt instruments offer a wide range of complex situations to be dealt with: various types of coupons, indexations and embedded options (callable, puttable…), convertible bonds, collateralized loans, securitizations, infrastructure debt…

The credit risk stemming from debt instruments has no natural mitigant in the liabilities of an insurer. The decision to invest in credit risk rather than in pure rate instruments (certain sovereign debts, for instance) is therefore driven by the balance between return, risk and the SCR. The study of the profitability of debt instruments under Solvency II is a key part of our analysis.

The SCR standard formula is complex and might appear unclear or ambiguous on some very specific aspects of debt markets. This document is not only a summary of the documents ruling the calculation of SCR. It also reflects our views and our understanding of some points, which raise specific issues in the context of Fixed Income instruments.

The first section of this document provides the big picture of the SCR standard formula. We then focus on the specificities of the SCR for debt instruments, with particular attention to the use of ratings and pricing models. A third section is dedicated to how profitability can be measured, taking into account the SCR.

- Quick links :

    - *Table of content* next page
    - *Acronyms and Definitions* page 29
    - *Index* page 31
    - *Reference* page 32

Table of content

I – Overview of the Standard Formula for the Market Risk Module and Counterparty Default Risk Module

The SCR calculation is split into several modules. In this document, we are only concerned with two of them: the Market Risk Module and the Counterparty Default Risk Module.

We have set out below the principles underlying the SCR calculation. The standard formula is scenario based and split into modules. The sub-modules are then aggregated using fixed correlations. The calculation of the Market Risk Module follows the same philosophy. It is also split into sub-modules, aggregated using fixed correlations.

One of the key points in the calculation of the SCR is the generalized use of a look-through approach. Financial instruments held by a mutual fund are considered to be held directly by the insurer invested in the fund, pro rata its investment. The same method applies to the financial instruments of mutual funds held by other mutual fund, etc.

The Market Risk Module is split into the following sub-modules:

- interest rate risk SCR_{IR},
- equity risk: SCR_{EQ},
- property risk: SCR_{PR},
- spread risk: SCR_{SPREAD},
- market risk concentrations: SCR_{CONC},
- currency risk: SCR_{FX}.

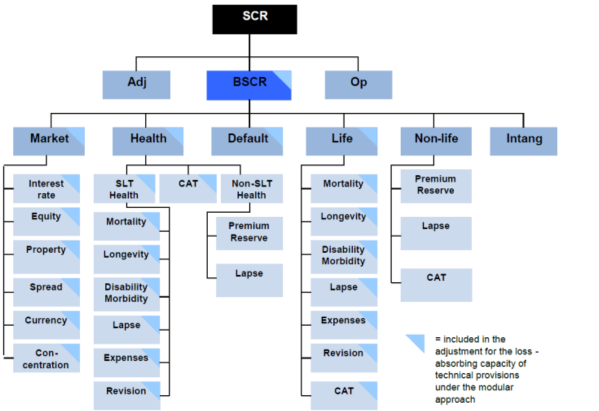

Figure 1: Standard Formula, source: EIOPA

As this paper focuses on debt instruments, we will only briefly consider the equity risk sub-module. Nevertheless, this sub-module has a direct impact on fixed income instruments if the insurer invests in convertible bonds, which are truly hybrid products (mixing equity, spread and interest rate risks in a complex way).

The property risk sub-module, not directly relevant for debt instruments, will also be mentioned briefly as it can have a slight influence through real estate collateral.

An important point is that there is no sub-module for volatility risk. This means that hedging strategies with out-of-the-money options can present interesting opportunities from an SCR perspective. This remark applies to rate options (swaptions, caps and floors) – which are widely used by insurers – as well as options on credit indices or on FX rates. Accordingly, there is no volatility cost for convertible bonds, which as a result provide cheap equity options when out of the money.

The Counterparty Default Risk Module applies to:

- Over-The-Counter (OTC) derivatives used for risk mitigation and contracts with Special Purpose Vehicles (SPV). These are included in the category "Type 1 exposures";
- Credit exposures not caught by the spread risk sub-module (or the Type 1 category above): These are included in the category "Type 2 exposures". These exposures are outside the scope of this note.

The main reference documents for SCRs are *Directive 2009/138/EC*, known as "Solvency II", and *Delegated Regulation (EU) 2015/35*, known as "Level 2", see *Reference p32*. For each SCR sub-module, the article numbers below refer to the articles in the Delegated Regulation. The definitions of each SCR can be found in the relevant article.

II – SCR for Debt Instruments

The following sub-modules apply to debt instruments:

- Interest rate risk sub-module (SCR_{IR}). This is an implicit risk in all fixed income instruments. This sub-module, unlike the others, can be set off against the insurer's liabilities.
- Spread risk sub-module (SCR_{SPREAD}). This is the main source of SCR for the majority of debt instruments. It is driven by the credit quality (or credit rating) and the sensitivity of the instrument with respect to its spread (modified duration).
- Market risk concentrations sub-module (SCR_{CONC}). This sub-module takes into account the default risk in a portfolio by calculating the concentration of risky issuers (measured by the credit rating).
- Currency risk sub-module (SCR_{FX}). This sub-module measures the risk of debt instruments that are not in the currency of the insurer. It is also impacted by hedging strategies for such instruments (FX forwards or futures).
- Equity risk sub-module (SCR_E). For debt instruments, this sub-module applies to the equity risk on convertible bonds and transitory equity positions which result when convertible bonds are exercised.
- Counterparty default risk module. This module is not involved in the Market Risk Module, but it has an important impact on OTC derivatives, used as risk mitigation techniques or held through mutual funds. This module mainly takes into account the default of counterparties, which is not already taken into account in the Market risk concentrations. Its formulation is complex, since it has a combined effect with the Market risk capital requirement of the OTC instruments. In this paper, this is the only aspect of the counterparty default risk module that we shall describe, but it has deeper ramifications for insurers, because it also covers contracts between insurers and reinsurers.

Complex structured notes, indexed on various sources of risks, will not be discussed in this paper. However, when a proper pricing model is available for such notes, it will be possible to calculate their SCR.

1. Interest Rate Sub-Module (Articles 164 to 166)

The interest rate sub-module is based on the calculation of losses under two opposite scenarios on the interest rate curves, which are given by the present value of the assets and liabilities minus, respectively:

- The present value of all interest rate curves subject to an upward shock (i.e. for all currencies)
- The present value of all interest rate curves subject to a downward shock (i.e. for all currencies)

It is important to note that these shocks concern both the assets and the liabilities of an insurer.

These shocks are defined currency by currency but are applied to each curve associated with the given currency. For instance, the same shock is applied to every swap curve for EUR denominated instruments: swaps on Euribor 6M, Euribor 3M, Eonia etc.

a. Calculation of the Risk Free Rate (RFR) Curve

The shocks are extracted from a set of instruments specified for each currency (either swaps or government bonds), for tenors longer than a year. They stem from an interpolation/extrapolation method (known as the Smith-Wilson method), which is described in detail in the document EIOPA-BoS-15/035 (available on the EIOPA website). Each month, EIOPA publishes the official curve for each currency. However, in order to monitor a portfolio on a daily basis, it is important to be able to produce such a curve under the current market conditions.

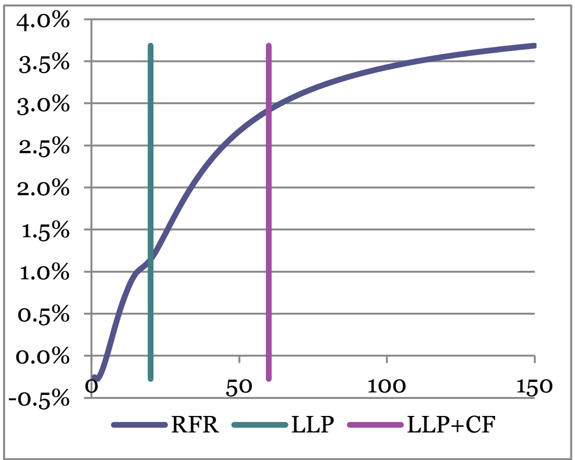

Figure 2: Zero-coupon RFR curve for EUR on 2016/01/31 (Source: EIOPA)

More information on EIOPA website: *https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii-technical-information/risk-free-interest-rate-term-structures*

The curve is calculated as follows:

- The market rates of the instruments are decreased by the Credit Risk Adjustment (CRA). We will come back to the calculation of this quantity below
- The curve is stripped in order to produce zero-coupon rates. This point is not clear in the documentation; it is our understanding of the methodology described by EIOPA.
- The zero-coupon rates are interpolated using the Smith-Wilson method up to the Last Liquid Point (LLP) which is given as a parameter for each currency (20 years for EUR).
- The interpolation method depends on a parameter α. This parameter is calibrated by a numerical procedure, so that the extrapolated rate is close to a given parameter called the Ultimate Forward Rate (UFR) at a maturity equal to the LLP plus the Convergence Factor (CF). The parameters UFR, LLP and CF are available for each curve and determined once and for all. The parameter α is given each month by EIOPA but should be calculated every day, as market conditions impact its value.
- The upward and downward shocks are deduced from the interpolated/extrapolated curve by applying fixed relative value shocks, under two restrictive conditions:
  - The upward shock is, as an absolute value, at least 1% (Article 166.2)
  - The downward shock is 0 for negative risk-free rates (Article 167.2)
- The shocks deduced from the previous steps are applied to each swap curve (through its zero-coupon form, i.e. stripped form) associated with the currency.

The shocks are given in the appendix *Relative Upward and Downward Shocks*. When a tenor is not in the list of shocks, a linear interpolation is applied in order to determine the appropriate shock.

Figure 2 displays the RFR curve as given by EIOPA on 31/01/2016. We have represented the LLP (20 years) and the LLP plus CF (20+40=60). The UFR is equal to 4.2%. After the LLP, the behavior of the curve is not driven by the corresponding market tenors. There is a sudden jump and then the rates converge towards the LLP at infinity. The tenors of the instruments underlying the curve (basically, the liquid swap rates in this case) are perfectly interpolated. Therefore, for instruments in EUR with a maturity of less than 20 years, the curve will not be very different from a curve stripped and interpolated by other, more traditional, methods.

The CRA is defined in Article 45, which states that it must be in the range [10bps; 50bps]. It reflects the credit risk involved in swap rates. Its precise calculation is available in EIOPA's document

BoS15/35 and is too long to be detailed here. However, let us say that, for the EUR, it is based on the difference between the 3 month Euribor rate and the rate of the 3 month EONIA swap.

a) Use of the shocked curves and aggregation

The shocked curves, for a given currency, are used to evaluate each instrument. It is interesting to note that even if the rates of the risk free rate curve are extrapolated beyond the LLP, their extrapolated value only comes into play through the shocks on the rates after this point. However, for the liabilities of the insurer the risk free rate curve is used as the discount curve. Under conditions the insurer can use a slightly different curve if he decides to use optional volatility adjustment or matching adjustment.

The shock (upward or downward) which is retained is the shock corresponding to the largest loss. The correlation matrix, which is used to aggregates the market risk sub-modules, changes depending on which shock is retained.

Assume that the capital requirements for the various sub-modules (the property sub-module) are calculated. Let $\overrightarrow{SCR_{MR}}$ be the following vector, where * denotes the transposition:

$$\overrightarrow{SCR_{MR}} = \left(SCR_{IR}, SCR_{SPREAD}, SCR_{CONS}, SCR_{FX}, SCR_{EQ}, SCR_{PR}\right)^*$$

The SCR for the market risk module is given by

$$SCR_{Market} = \left[\left(\overrightarrow{SCR_{MR}}\right)^* \cdot C \cdot \overrightarrow{SCR_{MR}}\right]^{\frac{1}{2}}$$

The correlation matrix C is given below. The first figure (in red) represents the correlation to be used when the upward shock is selected. The second figure (in green) represents the correlation to be used when the downward shock is selected.

	SCR_{IR}	SCR_{SPREAD}	SCR_{CONC}	SCR_{FX}	SCR_{EQ}	SCR_{PR}
SCR_{IR}	1	↑0/↓0.5	0	0.25	↑0/0.5↓	↑0/0.5↓
SCR_{SPREAD}	↑0/↓0.5	1	0	0.25	0.75	0.5
SCR_{CONC}	0	0	1	0	0	0
SCR_{FX}	0.25	0.25	0	1	0.25	0.25
SCR_{EQ}	↑0/↓0.5	0.75	0	0.25	1	0.75
SCR_{PR}	↑0/↓0.5	0.5	0	0.25	0.75	1

Table 1 : correlation matrix C for SCR_{MARKET} sub modules aggregation

Source: *Commission Delegated Regulation (EU) 2015/35* of 14 October 2014, Article 164.2

2. *Spread Risk Sub-Module: General*

The spread risk sub-module concerns all assets, financial instruments and debt instruments which are directly sensitive to a credit spread. It excludes the indirect spread effect induced by counterparty risk, such as for an OTC derivative. There are three types of SCR Spread, which apply to:

- Bonds and loans (SCR_{bonds} - see Articles 176 and 180). This covers government debt and corporate bonds and loans (excluding mortgage loans which are covered by the Counterparty Default Risk Module);
- Credit derivatives (SCR_{cd} - see Article 179). This covers, for example, CDS and structured products based on synthetic credit instruments.
- Securitizations (SCR_{sec} - see Articles 177-178. This covers, in particular, ABS.

The total SCR for the Spread Risk Sub-Module is given by

$$SCR_{SPREAD} = SCR_{bonds} + SCR_{cd} + SCR_{sec} \text{ (1)}$$

As all three quantities are only taken into account if they are positive, there can be no set off between, say, a bond and a CDS where the insurer is a protection buyer. However, under certain conditions, it is possible to set off the SCR spread for a bond against the SCR for its credit derivative hedge (see *Spread Risk Sub-Module: Derivatives (Article 179)*).

Basically, the spread risk is made up of two elements:

- The credit quality, which is represented by a Credit Quality Step (CQS), which is equivalent to an aggregated rating class (a CQS of 0 amounts to a credit rating of AAA, of 1 to a credit rating of BB etc.). We will come back to the construction of the CQS later on.
- The sensitivity of the instrument with respect to a shock on the credit spread:
  - For bonds, loans and notes, in general, this is a function of the spread duration, which is defined for each CQS. The function depends on the nature of the instrument, whether it is a government bond, corporate bond, covered bond or securitization... We have set out below the functions for the different categories.
  - For credit derivatives, it is the variation of the present value (PV) under certain upward and downward shocks, the size of which depend on the CQS. It is possible to set the SCR for certain derivatives off against each other (for example, long short CDS strategies). The shock which gives the maximum loss (after setoff) will apply.

At first glance, there seems to be a clear distinction between cash and synthetic debt. However, Credit Linked Notes (CLN) require particular attention. A CLN is, generally, a note issued by a bank or an SPV. The coupons and/or the capital take the risk under a synthetic credit derivative (on one or several entities). In this case, our interpretation is that:

- An SCR_{bonds} needs to be calculated in order to take into account spread of the issuer
- An SCR_{cd} needs to be calculated in order to take into account the underlying credit derivative

We have set out below some explanations about the CQS and the notion of spread duration.

a. <u>Basic facts on CQS (Articles 4 to 6)</u>

The CQS of an asset is based on the second best rating from 3 External Credit Assessment Institutions (ECAI) (or more). The choice of ECAI cannot be changed over the life of an instrument, and must be the same for similar debts.

If only one rating from an ECAI is available, this rating should be used. If only two ratings are available, the worst rating should be used.

Securitization positions with only one ECAI are considered to be unrated.

The correspondence between CQS and rating classes is as follows:

0	1	2	3	4	5	6
AAA	AA	A	BBB	BB	B	CCC

Table 2: CQS and rating classes correspondence

The correspondence above holds for the three major ECAI (Moody's, Standard & Poors, Fitch). Other ECAI can be used but for some of them, the highest rating does not correspond to a CQS of 0 but to a less favorable CQS. The list of the adjustments for each ECAI is available in a draft Commission Implementing Regulation (Commission Implementing Regulation laying down implementing technical standards with regard to the allocation of credit assessments of ECAIs to an objective scale of CQS).

b. Spread duration and embedded options

The spread duration represents the opposite of the derivative with respect to the spread of the price of the bond, divided by the (dirty) price of the bond. For a fixed rate bond, this quantity should not be materially different from the interest rate duration. If the bond has a floating rate, the spread duration is calculated by taking the forward value of each floating rate and considering that such rates are fixed. The interest rate duration can, in this case, be very different from the spread duration. The spread duration is expressed in years.

For the purpose of the SCR_{bonds} calculation the spread duration is floored at 1.

For callable bonds, to our knowledge there are no explicit requirements as to how to calculate the duration. Even if it is possible to calculate the duration as at the next call date, it may be important to take into account underlying Bermudian options to call the bond, implicitly sold by the investor to the issuer. This is particularly important for bonds with no maturity date (Tier 1) or bonds with a very long maturity (hybrid corporate bonds).

3. *Spread Risk Sub-Module: bonds and loans*

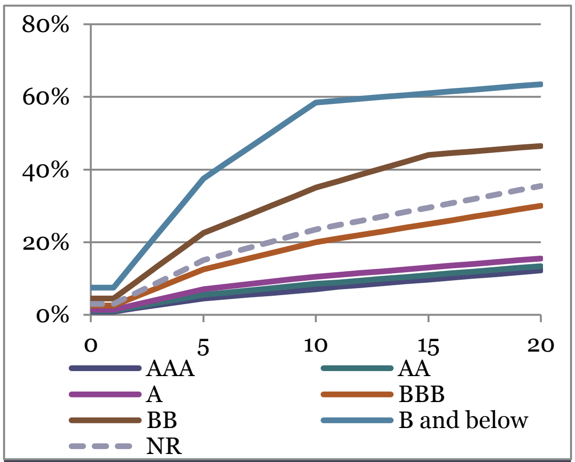

Figure 3: SCR$_{SPREAD}$ for corporate bonds a function of the spread duration (Source: Natixis AM)

For the Spread Risk sub-module for bonds and loans, there is a general case – basically for corporate senior-unsecured or subordinated debt – and a number of exceptions (government bonds, covered bonds, ...).

a. General case

This case, given in Article 176 1-5, concerns corporate bonds and loans, other than those listed in the specific categories described below in sub-sections b) to e). In particular, it covers all bank or corporate bonds and loans (public or private), regardless of the subordination of the debt.

Figure 3 displays the evolution of the SCR$_{bonds}$ as a function of the spread duration (in years) and for the various CQS, represented by their equivalent rating class. These shocks are applied to the market value of the bond or loan.

It is important to note that the shock for non-rated instruments is only slightly above the BBB shock (CQS = 3), but well above the BB shock (CQS = 4). In other words, the BB shock is much larger than the shock for non-rated instruments.

b. Government bonds, central and development banks and local collectivities (Article 180.2)

(i) A number of bonds and loans are exempt from SCR$_{bonds}$: bonds and loans of:

- The European Central Bank
- The central government and banks of Member States, issued in their own currency
- Certain multilateral development banks and international organizations

Example 1

In France, exposure to a région, département or commune is considered to be an exposure to the central government.

The exemption also applies to any bond or loan which is "fully, unconditionally and irrevocably guaranteed" by any of the above issuers.

The same favorable treatment applies to certain local authorities located in the states listed above. The entities that benefit from this exemption are listed in the document EIOPA-Bos-15/119 of June 30th 2015.

(ii) For the bonds and loans of central banks and states of countries which are not listed above (for instance, US or Japanese treasuries) and denominated in their own currency, specific shocks apply (Article 180.3). They are 0 for AAA and AA (CQS 0 and 1). The shocks for other CQS are displayed in *Figure 4*. We can see that, compared to corporate bonds, these shocks are much more favorable.

For example, for a BBB with a spread duration of 10, the shock is 10.5% for this type of sovereign bond and 20% for a corporate bond (see *Figure 3*).

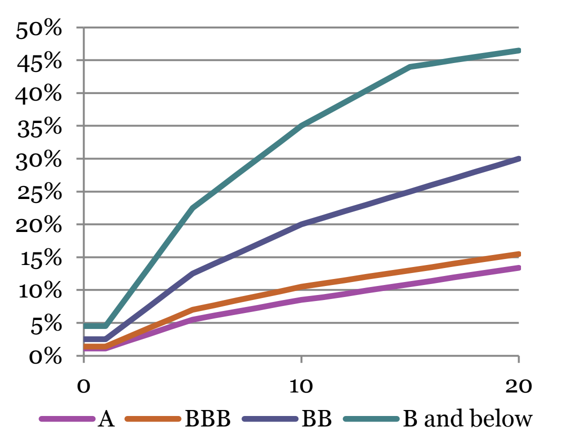

Figure 4: SCR spread for non-European sovereign bonds as a function of the spread duration (Source: Natixis AM)

For ratings below BBB, the shocks for the sovereign bonds are equal to the shocks for a corporate with a CQS which is one notch more favorable: BB sovereign bonds are treated as if they were BBB corporate bonds, B and below sovereign bonds are treated as if they were BB corporate bonds.

All sovereign bonds with a CQS denominated in the local currency benefit from these more favorable shocks. The others (foreign currency or non-rated) are treated as corporate bonds.

c. Covered bonds (Article 180.1)

Covered bonds, which are dealt with in Article 180.1, are defined in the European Directive UCITS IV (N° 2009/65/EC). This Directive defines a number of conditions in order for a bond to qualify as a "covered bond". In particular, the covered bond must be issued by a credit institution which has its registered office in a Member State.

Covered bonds which are rated CQS 0 and 1 (AAA and AA) benefit from a favorable treatment.

Figure 5 illustrates the difference between the SCR_{bonds} for covered bonds (continuous lines) and the SCR_{bonds} for standard bonds (dotted lines), for AAA and AA rating classes.

The contribution to the SCR_{bonds} of a AA covered bond is equivalent to the contribution of a AAA standard corporate bond.

Example 2

A bond from a French Agency (such as CADES) issued in EUR and guaranteed by the French Government does not attract an SCR spread. The same bond issued in CHF would have the same treatment as a corporate bond (see *Government bonds, central and development banks and local collectivities (Article 180.2)*).

d. Non-rated collateralized bonds and loans

For bonds or loans for which no credit assessment by a nominated ECAI (a non-rated bond) is available, but which are collateralized, it is possible to decrease the amount of SCR_{bonds}. In some circumstances, it is even possible to divide the classic SCR_{bonds} in half.

The conditions for the collateral mechanism to be eligible are set out in Article 214 (together with Articles 209 and 210), most of which are very subjective. Some of the key points are summarized below:

- If a credit event occurs, the insurer can liquidate or retain the collateral
- The collateral has a sufficient liquidity and a sufficient credit quality, and is stable in value
- It is guaranteed by a counterparty for which no risk factor for concentration applies (cf. *II – 7*)
- There is no "material correlation" between the credit quality of the collateral and the credit quality of the counterparty

It is possible for a custodian to hold the collateral provided that certain criteria are met.

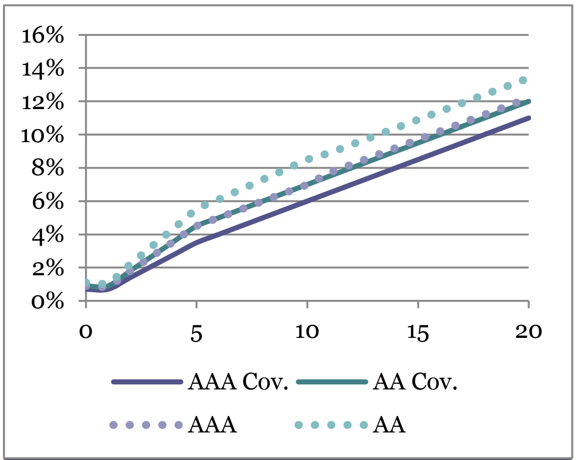

Figure 5- SCR spread for AAA-AA standard and covered bonds, as a function of the spread duration (Source: Natixis AM)

If the collateral is deemed eligible, the reduction of the SCR_{bonds} is calculated using a complicated formula. The calculation is based on the Risk Adjusted Value of Collateral (RAVC). Depending on the RAVC, the SCR_{bonds} may or may not be reduced. Let us consider the Market Value of the bond or loan (MV) and denote by "F^{up}" the shock corresponding to this bond or loan, without collateral, as a proportion of MV. Accordingly, we denote by "$F^{up}(collat)$" the shock corresponding to this bond or loan, with the collateral. There are three different situations:

- If RAVC ≥ MV, then the shock is divided by 2, i.e. $F^{up}(collat)=0.5\times F^{up}$
- If RAVC < MV × (1- F^{up}), then the shock is unchanged, $F^{up}(collat)= F^{up}$
- If RAVC < MV and RAVC ≥ MV ×(1- F^{up}), then we calculate a new shock by linear combination between the two previous situations:

$$F^{up}(collat) = 0.5 \times F^{up} + 0.5 \times \frac{MV - RAVC}{MV}$$

In other words, we compare the value of the stressed collateral to the value of the bond or loan. If the valued of the stressed collateral is higher than the market value of the bond or loan, the impact on the SCR spread is very favorable.

Example 3

A covered bond issued by a US bank and denominated in EUR is not eligible for the reduced shock. A covered bond issued by a UK bank and denominated in EUR may benefit from the reduced shock, provided that the other conditions are fulfilled.

Now, let us turn to the calculation of RAVC, as defined in Article 197. The RAVC is the difference between the Market Value of Collateral (MVC) and the Market Risk of Collateral (MRC)

$$RAVC = MVC - MRC$$

It is not clear in the Delegated Regulation whether the calculation of MRC is performed for a specific collateralized bond or loan or at an aggregated level (all collateralized bonds and loans). Our interpretation is that the calculation should be performed for each specific collateralized bond or loan. The MRC is the difference between:

- The theoretical SCR for Market Risk for the bond/loan without any collateral. This SCR is calculated by aggregating the various sub-modules using the correlation matrices.
- The theoretical SCR for Market Risk for the bond/loan with the collateral

The idea underlying this calculation is that the MRC must always be positive, because the collateral is intended to reduce the SCR. However, when the collateral is a real asset (aircraft, real estate etc.), and the risk on the collateral is significantly larger than the SCR for Market Risk that applies to the bond or loan, the direct application of this formula may result in a negative MRC, and therefore, a RAVC greater than MVC.

For example, let us consider the case of a floating rate loan collateralized by a real estate. We assume that "Loan To Value" (LTV) is smaller than one (value of the collateral larger than the value of the loan). The collateral is only affected to the Property risk sub-module, which is given by an instantaneous decrease of 25% in the value of the property. Therefore, the collateral induces a SCR for market risk which is significantly larger than the SCR spread of the loan (the interest rate risk is not material for a floating rate note). Indeed, the SCR spread, for a duration of 5 years, would be 3%×5=15% of the value of the loan. Should the formula above apply, this would result in a negative MRC, and, therefore, a RAVC larger than the MVC, which is larger than the MV (because the LTV is smaller than 1). Hence, the strict application of the formula would always lead to a shock divided by 2. From our point of view, it seems more conservative to state that MRC = 25% × MVC (which is the risk of decrease of the collateral market value). This leads to RAVC = 75% × MVC.

This example could be extended by applying the Type 2 equity shock to the collateral, when it has no specific market shock (e.g. Aircraft debt). With this conservative approach, we see that the effect of the collateral on the spread risk depends on the LTV (increasing function of the LTV).

4. *Spread Risk Sub-Module: Infrastructure debt (Articles 180.11, 180.12, 180.13)*

Specific shocks for infrastructure debt apply since 2 April 2016 (see Commission Delegated Regulation (EU) 2016/467).

Infrastructure debt benefits from reduced shocks of approximately 30% compared to corporate debt, if the underlying infrastructure project satisfies certain requirements. Among other conditions, the infrastructure and the debt instruments (bonds or loans) must meet the following criteria, which are included in Article 164.a:

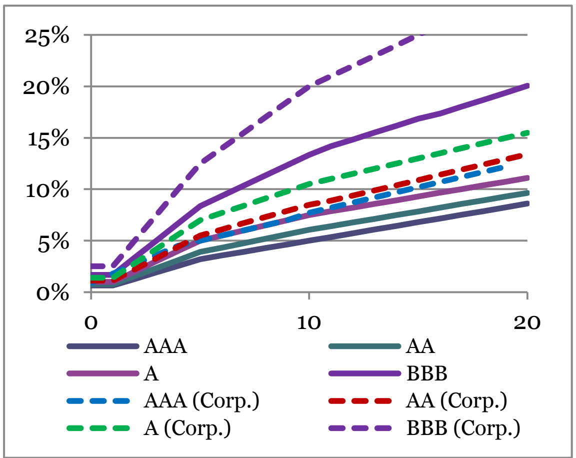

Figure 6: SCR spread comparison between infrastructure and corporate bonds (Source: Natixis AM)

- The infrastructure project is located in the European Economic Area (EEA) or the Organization for Economic Co-operation and Development (OECD)
- If no CQS is available, the bond is senior to all other claims. If no CQS is available, but the specific criteria are met, the bond is treated as if it has a CQS of 3 (BBB). Any instruments with a CQS of less than 3 (BBB) will not qualify.
- The bond holders are protected by a certain number of covenants concerning the use of the cash flows generated by the infrastructure.

5. *Spread Risk Sub-Module: Securitizations (Articles 177 to 178)*

There are two categories of securitizations: Type 1 and Type 2. A third approach, which is even more conservative, applies to re-securitizations.

a. Type 1 Securitizations

Type 1 securitizations correspond to the less risky assets. Even if the capital requirement is higher than the requirement for corporate bonds (for the same CQS), the capital requirement for Type 1 securitizations are still much lower than those that apply to Type 2 securitizations. This distinction between Type 1 and 2 has a major impact on the value of SCR_{sec}. Some of the key features that must be respected by a Type 1 securitization include:

- The securitization must have a CQS of 3 or less.
- It must be listed on a market located in the EEA or OECD, although it may also be listed on an organized trading venue which is sufficiently liquid and for which the infrastructure is sufficiently robust.
- It is the most senior tranche or one of the senior tranches if several tranches are pari passu. In our view, a tranche which is currently the most senior and will be so during the remaining life of the structure can be deemed to be the most senior, even if in the past this tranche was subordinated to another tranche which has been completely amortized.
- The notes are issued by a Special Purpose Entity and the note holders do not bear any risk on the seller of the note.
- The pool of underlying loans is homogeneous and of one of the following types:
    - Residential loans (with mortgages or collateral)
    - Commercial loans, leases and facilities to finance operations other than for the acquisition of commercial real estate, provided that at least 80% of the borrowers are small and medium size firms (80%)
    - Auto loans and leases
    - Loans to individuals for personal, family or household consumption purposes
- It is not a re-securitization
- The pool does not include impaired obligors on the date of issue of the securitization

Surprisingly, it seems that Collateralized Loans Obligations (CLO) of Senior Secured Loans are excluded from Type 1, but CLO of loans for small and medium sized firms are eligible. Commercial Real Estate securitizations are also excluded from Type 1.

The contribution to SCR_{sec} of a Type 1 securitization, with a CQS c of {0,…,3}, is obtained by multiplying its market value by:

$$min\{b_1(c) \times max\{duration; 1\}; 1\}$$

Here, *duration* represents the spread duration of the securitization, as defined for bonds in Section 3-d, and b_1 is equal to the value set out below for the relevant CQS:

CQS	0	1	2	3
b_1	2.1%	3%	3%	3%

Table 3: b_1 value by CQS

However, when a Type 1 securitization is fully guaranteed by the European Investment Fund or the European Investment Bank, its contribution to SCR_{sec} is 0, provided that the conditions on the guarantee, set out in Article 215, apply.

a) Type 2 Securitizations

A securitization which is not Type 1 and which is not a re-securitization is Type 2. The contribution to SCR_{sec} of a Type 2 securitization, with a CQS c, is obtained by multiplying its market value by:

$$min\{b_2(c) \times max\{duration, 1\}; 1\}$$

Here, b_2 is equal to the value set out below for the relevant CQS:

CQS	0	1	2	3	4	5	6	Non-rated
b_2	12.5%	13.4%	16.6%	19.7%	82%	100%	100%	100%

Table 4: b_2 value by CQS

b) Re-securitizations

A re-securitization, with a CQS c, has a contribution to SCR_{sec} which is obtained by multiplying its market value by:

$$min\{b_3(c) \times max\{duration, 1\}; 1\}$$

Here, b_3 is equal to the value set out below for the relevant CQS:

CQS	0	1	2	3	4	5	6	Non-rated
b_3	33%	40%	51%	91%	100%	100%	100%	100%

Table 5: b_3 value by CQS

6. *Spread Risk Sub-Module: Derivatives (Article 179)*

This part of the Spread Risk sub-module differs from the other parts because the shock is based on a difference of the present value (PV) under stressed and initial market conditions. The shock is the higher of the following:

- The loss of PV due to an increase in credit spreads, in absolute terms, and depending on the CQS of the underlying reference entity (in our view, the rating for the reference entity itself). The absolute shock in spreads is given in the following table

CQS	0 (AAA)	1 (AA)	2 (A)	3 (BBB)	4 (BB)	5 (B and below)	Non-rated
Shock (%)	1.3	1.5	2.6	4.5	8.4	16.2	5

Table 6: instantaneous increase in spread by CQS

- The loss of PV due to a decrease in credit spreads, in relative terms, equal to 75%, regardless of the CQS

When the underlying reference entity is one of the governmental entities which is exempted from SCR_{bonds} (see section *II – 3.b*), the shock for the derivative is equal to 0 (Article 180-9).

We assume that the credit derivative is used to hedge a risk (risk mitigation technique) on a particular investment. If there is no material basis risk between the initial exposure and the hedge, the credit derivative is not subject to Spread Risk. On this specific point (Article 179.3) it is not explicitly stated that we can also remove the Spread Risk for the instrument which is hedged. However, it would seem natural to do so. In the same way, there is no mention that such a hedge impacts the market risk concentrations sub-module. We will consider this question further in the section dedicated to this sub-module (Section 7).

According to Article 209-2, only risk mitigation techniques that will be in force for at least the next 12 months shall be fully taken into account.

7. Market Risk Concentrations Sub-Module (Articles 183 to 187)

This sub-module measures the exposure on direct investments (debt or equity), as opposed to indirect credit exposure through counterparty risk (e.g. on OTC derivatives).

It is different in nature from the other sub-modules, as it is based on non-linear calculations for each group of issuers. Contrary to the other sub-modules, a fund manager cannot only communicate the global figures for this sub-module at the level of a fund. The insurer must also have non-aggregated data on this sub-module at the level of each fund (average exposure, average rating…).

The expositions are calculated for different issuer groups. In our view, it seems natural to mix CDS and bond positions on the same issuer group, to allow risk mitigation. Although this is not clearly stated, Article 182.3 seems to indicate that this is acceptable.

The first step is to calculate the weighted average of the CQS among an issuer group. The weights are given by market value. The average CQS is rounded-up. Non-rated exposures are given an arbitrary CQS of 5.

There is no market risk concentration for government bonds for which the SCR_{bonds} component is 0, as described in Section 3-b) (i) (Article 187.3). For other government bonds, specific parameters apply, as set out below.

The market risk concentration for covered bonds, as described in section 3-c), is reduced (Article 187-1), as set out below. In the following, we consider each couple of issuer and level of guarantee (eligible covered or not).

Let us assume that the whole exposure of an issuer can be split into J issuer groups. For the couple (issuer, guarantee) number $j \in \{1, \cdots, J\}$, we have:

- The weighted average exposure to this issuer group and level of guarantee ("Ej"), and calculated as described above
- The weighted CQS of the issuer group and level of guarantee ("CQSj")

The total value of all the assets covered by the market risk concentrations sub-module is denoted by A. The precise scope for the calculation of this quantity is described in Article 184.2. For fixed income assets, it excludes almost all the exposures covered by the counterparty risk sub-module. There are two mappings of the CQS, denoted by CT and g, which represent, respectively, the relative excess exposure threshold and a risk factor that magnifies the exposures on the worst CQS. They are given in the following table (except for the covered bonds described in Section 3-c):

CQS	0	1	2	3	4	5	6
CT	3%	3%	3%	1.5%	1.5%	1.5%	1.5%
g	12%	12%	21%	27%	73%	73%	73%

Table 7: relative excess exposure and risk factor by CQS

If the assets are covered bonds as described in Section 3-c), the threshold CT is equal to 15%.

If the assets are government bonds denominated in their local currency, as described in Section 3-b) (ii), the following mapping g shall be used (Article 187.4):

CQS	0	1	2	3	4	5	6
g	0%	0%	12%	21%	27%	73%	73%

Table 8: risk factor by CQS

The excess exposure threshold represents the exposure under which there is no concentration risk for an issuer and level of guarantee, given its weighted average CQS. It applies to the total value of assets, A. The capital requirement for the market risk concentrations sub-module is given by:

$$SCR_{conc} = \left[\sum_{j=1}^{J} g(CQS_j) \times max\{E_j - A \times CT(CQS_j); 0\}\right]^{\frac{1}{2}}$$

It is important to highlight that this formula is non-linear, as opposed to the interest rate or spread risk for bonds sub-modules. The aggregation for a given issuer group can be performed only at the level of the insurer and not at the level of the different funds held by this insurer. However, the exposures on the same issuer group are additive and the weighted CQS for the same issuer group can be compounded by weighting them by their exposures.

8. Currency Risk Sub-Module (Article 188)

The currency risk sub-module is based on the reference currency of the insurer or domestic currency. For example, for an insurer based in the Euro Area, the Euro is the domestic currency. Every exposure to assets which only depend on the domestic currency does not contribute to this sub-module. Every other currency will be considered as a foreign currency, their FX rate will be represented against the domestic currency (number of units of the domestic currency for 1 unit of the foreign currency). The capital requirement is the larger of the following quantities:

- An instantaneous increase in the value of all foreign currencies against the domestic currency
- An instantaneous decrease in the value of all foreign currencies against the domestic currency

The increase and decrease are, respectively, 25% and -25%, of the current value of the FX rate.

There are exceptions for currencies pegged to the domestic currency: Article 188.5, implemented in Commission Implementing Regulation (EU) 2015/2017 of 11 November 2015 CELEX:32015R2017 for currencies[1] DKK, BGN, XOF, XAF and KMF pegged to Euro.

The existence of an increase and a decrease captures the mitigation effect of products such as FX forward agreements or FX futures used to hedge assets in foreign currencies.

9. Equity Risk Sub-Module (Article 168)

Two classes of assets are defined for the equity risk sub-module: Type 1 and Type 2. Whereas Type 1 only applies to equities, Type 2 may cover other risks. Type 2 is used as a fallback category for all risks not explicitly covered by the Regulation. More precisely:

- Type 1 equities cover equities listed on regular markets of the EEA and OCDE, together with equities held through specific collective investment vehicles (social entrepreneurship or venture capital funds, as described in Article 168.6)
- Type 2 equities cover:
    - Equities listed in countries not in the EEA and the OCDE
    - Non-listed equities
    - Commodities and other alternative investments
    - All assets not covered in the other sub-modules (interest rate, property, spread), including those for which the look-through approach is impossible
- Qualifying infrastructure equities :
    - Commission Delegated Regulation (EU) 2016/467 introduced a specific capital requirement for qualifying infrastructure equities,

[1] See *Acronyms and Definitions* for Currencies full name

- equity investments in infrastructure project entities that meet the criteria set out in Article 164a

The capital requirement for the equity sub-module, denoted by SCR_{equity}, is obtained by aggregating capital requirements for Type 1 equities (SCR_{E1}) on one hand, Type 2 equities (SCR_{E2}) and Qualifying infrastructure equities (SCR_{quinf}) on the other, with a correlation factor of 0.75:

$$SCR_{equity} = \left[SCR_{E1}^2 + \left(SCR_{E2} + SCR_{quinf}\right)^2 + 2 \times 0.75 \times SCR_{E1} \times \left(SCR_{E2} + SCR_{quinf}\right)\right]^{\frac{1}{2}}$$

In the following, we only take into account the standard equity risk sub-module (Article 169) and not the duration based equity sub-module (Article 170), which is not relevant to fixed income instruments.

The equity risk sub-module is based on an instantaneous decrease of the value of the equity markets. The size of the decrease depends on the type of equity. Four different cases apply:

- A decrease of 22% is applied to equities qualifying as strategic investments
- A decrease of 39% is applied to Type 1 equities
- A decrease of 49% is applied to Type 2 equities
- As a transitional measure, a decrease of 22% is applied to Type 1 equities purchased on or before 1 January 2016. This is not relevant for the fixed income assets we are considering here.
- A decrease of 30% is applied to Qualifying infrastructure equities

These decreases are adjusted by a factor, called the Symmetric Adjustment (SA) sometimes mentioned as “Dampener”, which takes into account the 36 month average of the equity markets, represented by the weighted average of a number of indices (CAC 40, DAX, S&P 500, Nikkei 225 etc.). The list of indices and weights can be found in the Appendix hereto. The SA is published every month by EIOPA. However, it can also be calculated, if necessary on a daily basis. SA varies between +10% and -10%. SA is fully applied to Type 1 and 2 equites, a 77% of SA is applied in the case of Qualifying infrastructure equities.

The only fixed income assets for which equity risk is relevant are convertible bonds. Given the size of the equity shock, convertible bonds have to be priced under stressed equity conditions in order to calculate the loss on the bond (as opposed to a delta-based method). For convertible bonds which are unlikely to be converted (where the price is therefore mainly driven by the spread risk), the impact of the equity shock is not material. These bonds are mainly affected by the spread sub-module and not the equity sub-module. For bonds which are likely to be converted, the impact of the equity shock has a substantial effect on the price. In this case, the main contribution to the SCR comes from the equity sub-module.

To our knowledge, no stress is applied to instruments such as futures on dividends.

10. Counterparty Default Risk Module (Article 189-202)

a. Variance for Type 1 Exposures

As mentioned in the introduction, the scope of this paper is covered in the "Type 1" exposures of the counterparty default risk module:

- Risk mitigation contracts involving SPV and derivatives.
- Deposits from banks, that can be encountered, for instance, in money market funds

Some repo agreements proposed by banks, to remove from its balance sheet securitization transactions, may fall in this module. A typical form is a repo by which the insurer lends, for a given period, good quality assets (government bonds) to obtain a pick-up on its return, and receives securitizations as collateral.

The mechanism of the counterparty default risk of Type 1 exposures involves the following important features:

- The collateral is taken into account with a stress. This mechanism is the same as the one already seen in Section II.2.d (non-rated, collateralized bonds)
- The exposure is taken at the level of single name entities, in a way similar to the approach of the market risk concentrations sub-module (Section II.6).
- The probability of default of the counterparties, deduced from their CQS, and the probability of joint default of these counterparties are taken into account

The variance V of the loss distribution of Type 1 exposures is split into V_{inter} and V_{intra}. These quantities are based on the whole set of single name exposures. Let us denote by N the number of different Type 1 single name exposures and M the number of different probabilities of default among these single name exposures (M is smaller than N). For any single name exposure, k ∈[1, ..., N}, we denote by L[k] its loss given default, and by P[k] its default probability. We define V_{inter} and V_{intra} as follows:

$$V_{inter} = \sum_{1 \le i,j \le M} TL_i TL_j \frac{P_i(1-P_i)P_j(1-P_j)}{1.25 \times (P_i + P_j) - P_i P_j}$$

$$V_{intra} = \sum_{1 \le j \le M} \frac{1.5 \times P_j(1-P_j)}{2.5 - P_i} \times \sum_{k=1}^{N} L[k]^2 \times \begin{cases} 0 \text{ } if \text{ } P[k] \neq P_j \\ 1 \text{ } if \text{ } P[k] = P_j \end{cases}$$

In this formula, TL_i represents the sum of the loss-given default over single name exposures with default probability P_i, i ∈{1, ..., M}. In our conventions, the set of the P_i, where I ranges from 1 to M, is exactly the set of the P[k], where k ranges from 1 to N. In the following, L will be the total loss-given default of the Type 1 exposures. The capital requirement is based on V = V_{inter} + V_{intra} through the following stratification of the variance (Article 200):

$$SCR_{def,1} = \begin{cases} 3\sqrt{V} & if \sqrt{V} \le 7\% \times L \\ 5\sqrt{V} & if \text{ } 7\% \times L < \sqrt{V} \le 20\% \times L \\ L & if \sqrt{V} > 20\% \end{cases}$$

The capital requirement for counterparty default risk is then obtained by aggregation of Type 1 and Type 2 capital requirements, with a correlation of 0.75.

In order to apply the previous formulae, the form of the probabilities of default as well as the loss-given default should be clarified. This is dealt with in the following sub-sections.

b. Loss-Given Default (Article 192)

The loss-given default represents the amount of loss in case of default of the counterparty, mitigated by the collateral and the market effects of the default. We shall focus on derivatives (Article 192-3), which is the most important in the context of this note. The other cases concern reinsurance arrangements and mortgage loans which do not fall within the SCR Spread for securitizations.

The loss-given default is calculated at the level of a single name exposure as the sum of all loss-given default of derivatives related to this single name exposure.

The loss-given default for a derivative or a set of derivatives with the same bank and covered by the same collateral agreement is given by

Example 4

Assume that an insurer invests in two funds, each of them holding OTC derivatives with the same bank (or entities of the same bank). Each fund has its own Credit Support Annex (CSA), which covers the counterparty risk for the derivatives, through collateral exchange. Our interpretation is that the loss-given default is calculated for each fund, using the level of collateral used in this fund, and aggregated in the total loss-given default for the single name exposure corresponding to the bank.

$$LGD = max\{90\% \times (D + RM) - F \times C\}$$

This equation uses the following variables:

- The value of the derivative(s), D
- The risk mitigating effect of the market risk of the derivative(s), RM (cf. Article 196). This adjustment takes into account the impact on the Market Risk SCR of a default of the counterparty. This is because, if the counterparty defaults, the derivative no longer acts as a risk mitigation instrument which can decrease the Market Risk SCR.
- The risk-adjusted value of the collateral, C (cf. *II – 3.d*)

The constant F is chosen according to Article 197.7 and can be either 100% or 90%.

c. Default Probability (Article 199)

The default probability is calculated at the level of a single name entity as the average of the default probabilities on exposures to counterparties included in this single name exposure, weighted by the loss given default.

In the following, we only consider the case where the counterparty is a bank, which is the central case for OTC derivatives. In particular, we do not cover the case where the counterparty is an insurer or a reinsurer. If a CQS is available on a single name exposure, the following default probabilities P apply:

CQS	0	1	2	3	4	5	6
P	0.002%	0.01%	0.05%	0.24%	1.20%	4.20%	4.20%

Table 9: default probabilities by CQS class

Financial institutions without CQS – but which satisfy some restrictive solvency conditions (cf. references in Article 199.6) – are assigned a default probability of 0.5%.

Counterparties corresponding to the entities listed in Section 3.b.ii (ECB, EEA governments and central banks, development banks…) are assigned a probability of 0%.

A counterparty which does not fall into one the previous cases is assigned a probability of 4.2%.

III – Profitability under Solvency Capital Requirement

For an insurer, the profitability of a debt instrument should take into account the SCR. Even if the impact of an instrument on the SCR should probably be analyzed on an aggregate basis, it is possible to draw some conclusions as to the profitability of stand-alone debt instruments. The purpose of this section of the paper is to define the methods for determining the profitability of a stand-alone instrument and to illustrate how these methods behave when applied to certain classes of debt instruments.

1. Risk Adjusted Return on Capital

The idea is to consider that the internal rate of return of a given debt instrument is affected by the SCR that applies specifically to this instrument. Our approach is based on the following analogy, on the following fictitious instrument:

- The instrument is purchased by the investor at its market price plus a capital add-on (depending on the SCR, as discussed below).
- The investor receives the scheduled cash flows of the instruments of both capital and interest (for instance, calculated on a forward curve for floating rate notes)
- The investor receives the variation of the capital add-on induced by the reduction of the capital (in case of amortization) and of the duration (time decay on the spread risk module, for instance)
- At maturity, the investor receives the remainder of the capital add-on.

This approach is very similar to the concept of Risk Adjusted Return On Capital (RAROC), generally used by banks to determine the profitability of their investments.

As explained in Part I, the interest rate risk module has a specific role for the insurer. Therefore, we exclude the SCR for interest rate risk from our analysis. The capital add-on of the instrument is the sum (using the relevant correlation coefficients) of the SCR stemming from the other sub-modules:

- Spread risk
- Equity risk, for convertible bonds

In this approach, we exclude debt instruments in foreign currencies. The returns of these instruments are not known and would require more complex methods. However, if a bond in a foreign currency is hedged (forward or swap), we can calculate a return in the domestic currency and use the approach below with this return.

Let us consider a finite sequence of increasing dates (expressed in years) $(T_i)_{0\le i\le N}$, corresponding to the payments (capital and interest) under the debt instrument. The date $T_0 = 0$ is assumed to be the settlement date, where the instrument is purchased. The flow at time T_i, $1\le i\le N$, is denoted by $F_i > 0$, and includes both capital and interest. The buying price is $P_0 > 0$. The capital add-on at time T_i, $1\le i\le N$, is denoted by $S_i \ge 0$, and involves the sub-modules listed above. By convention, $S_N = 0$, meaning that there is no more add-on at maturity. The RAROC is defined by the rate R which solves

$$P_0 + S_0 = \sum_{i=1}^{N} \frac{F_i + (S_{i-1} - S_i)}{[1+R]^{T_i}}$$

If there is no capital add-on (for a government bond with no SCR spread, for instance), the RAROC is equal to the internal rate of return.

It is possible to use a simplified version of this formula. Assuming that y is the internal rate of return of the debt instrument, and that the capital add-on S is constant up to maturity T, we can define the RAROC as follows:

$$R = \left[\frac{(1+y)^T + S}{1+S}\right]^{\frac{1}{T}} - 1$$

This formula basically states that the capitalized income of the bond at maturity, i.e. $(1+y)^T$, and the capital add-on S, are considered as the outcome of an investment at cost 1+S, with maturity T.

A first-order development, for small values of S, provides

$$R = y - \frac{(1+y)}{T} \times \left[1 - \frac{1}{(1+y)^T}\right] \times S + \ o(S)$$

2. *Examples on bond markets*

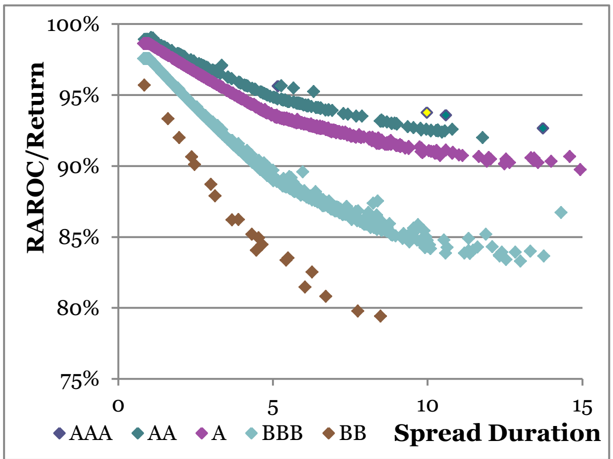

Figure 7: RAROC on return for a sample of corporate EUR bonds, as a function of the spread duration (Source: Natixis AM, data as-of 06 April 2016)

In order to illustrate the use of the RAROC for bonds, we calculated this quantity for a sample of EUR, fixed rate, corporate bonds (not including covered bonds) on 6 April 2016. We grouped the bonds by rating class, in order to have a clear view of the rating on the RAROC. We then looked at the quantity equal to RAROC/y as a function of the spread duration. This represents the impact of the SCR on the RAROC. We can see in *Figure 7* that the rating class samples are clearly separated. Their general shape s decreases with the duration, even if there is certain dispersion around the general trend of each sample, especially for BBB-rated assets. This is due to the large scale of returns (y) in the BBB sample, ranging from 30bps to some 600bps, for spread durations around 5 years. The difference between the return and the RAROC is substantial for the BBB class: there is a decrease of more than 10% for a spread duration of 5 years.

The BBB class is the most highly represented in the sample and has a large dispersion. Roughly speaking, a lot of BBB and A rated assets have the same level of RAROC, whatever the spread duration. This is particularly evident in this period of tension in some sectors of the credit markets (utilities, energy and materials).

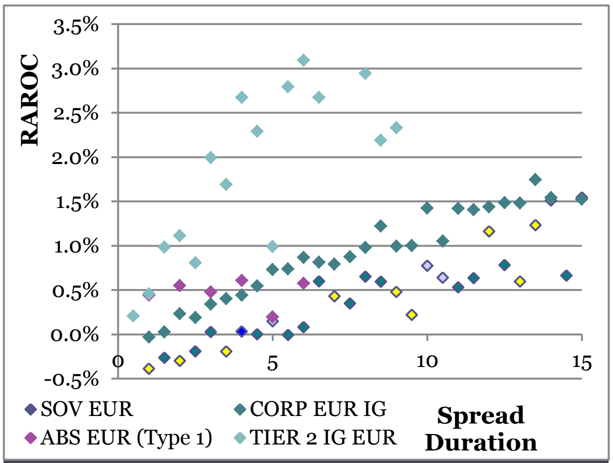

Figure 8: RAROC for several samples of bonds and securitization, as a function of the spread duration (Source: Natixis AM. Data as of 11 April 2016)

The RAROC can be also a useful way to analyze the profitability among various classes of assets. An example of this approach is displayed in Figure 7, where the RAROC of several types of assets are represented as functions of the spread duration: Eurozone sovereign bonds, senior unsecured corporate investment grade (IG) bonds, Type 1 ABS in EUR and Tier 2 IG bonds in EUR. The RAROC is calculated on 06 April 2016. The samples of corporate IG bonds and Type 1 ABS are represented by their averages on every interval of duration of 0.5 year. One of the important features seen in *Figure 8* is that Type 1 ABS can be compared to corporate IG bonds in terms of RAROC, even if the securitization SCR spread is less favorable than for bonds. Moreover, we see a stratification of the other categories: sovereign bonds under senior unsecured corporate bonds, and senior unsecured corporate bonds under Tier 2 bonds. This stratification tends to be consistent over time. However, the average on senior unsecured IG corporate bonds tends to limit the dispersion, and, therefore, the variability of this sample.

IV – Conclusion

Under the Solvency II Capital Requirements for Fixed Income instruments, and in particular debt instruments, there are a large number of treatments for very specific risks taken by the insurer: spread risk, market risk concentrations, etc. Some classes of debt instrument benefit from a more favorable spread risk capital requirement, such as infrastructure debt and, to a certain extent, collateralized non-rated bonds or loans. Other classes – particularly securitizations – are penalized.

Certain characteristics of debt instruments are not taken into account under Solvency II. For example, the seniority of the bond is only captured through the rating of the instrument. The treatment of other risks is not clearly described, such as call options embedded in subordinated bonds.

The capital requirement is only one aspect of an investment in a debt instrument. More important is the relationship between the capital requirement and the return, which gives the overall profitability. In this paper, we suggest using the RAROC to measure the profitability, as it is a simple way of quantifying the trade-off between profitability and the cost of capital.

V – APPENDIX

1. Relative Upward and Downward Shocks

The part of the following table highlighted in grey is based on the linear interpolation of the shocks. The other part is given directly in Articles 165 and 166. These shocks are applied to the zero-coupon RFR curve.

Source: *Commission Delegated Regulation (EU) 2015/35* (CELEX:32015R0035) & Natixis AM

Tenor (year)	Upward	Downward
1	70.0%	-75.0%
2	70.0%	-65.0%
3	64.0%	-56.0%
4	59.0%	-50.0%
5	55.0%	-46.0%
6	52.0%	-42.0%
7	49.0%	-39.0%
8	47.0%	-36.0%
9	44.0%	-33.0%
10	42.0%	-31.0%
11	39.0%	-30.0%
12	37.0%	-29.0%
13	35.0%	-28.0%
14	34.0%	-28.0%
15	33.0%	-27.0%
16	31.0%	-28.0%
17	30.0%	-28.0%

Tenor (year)	Upward	Downward
18	29.0%	-29.0%
19	27.0%	-29.0%
20	26.0%	-29.0%
25	25.6%	-28.4%
30	25.1%	-27.7%
35	24.7%	-27.1%
40	24.3%	-26.4%
45	23.9%	-25.8%
50	23.4%	-25.1%
55	23.0%	-24.5%
60	22.6%	-23.9%
65	22.1%	-23.2%
70	21.7%	-22.6%
75	21.3%	-21.9%
80	20.9%	-21.3%
85	20.4%	-20.6%
90	20.0%	-20.0%

Table 10: relative Upward and Downward Shocks

2. Indices and weights for the construction of the symmetric adjustment

Source : *Commission Implementing Regulation (EU) 2015/2016* (CELEX:32015R2016)

Equity indices	Weights
AEX	0.14
CAC 40	0.14
DAX	0.14
FTSE All-Share Index	0.14
FTSE MIB Index	0.08
IBEX 35	0.08
Nikkei 225	0.02
OMX Stockholm 30 Index	0.08
S&P 500	0.08
SMI	0.02
WIG30	0.08

Table 11: indices and weights for the construction of the symmetric adjustment

VI – Table of Illustrations

VII – Acronyms and Definitions

BGN: Bulgarian lev (currency)
CF: Convergence Factor
CLN: Credit Linked Note
CHF: Swiss Franc (currency)
CRA: Credit Risk Adjustment
CQS: Credit Quality Step
DKK: Danish Krone (currency)
ECAI: External Credit Assessment Institutions
EIOPA: European Insurance and Occupational Pensions Authority
EEA: European Economic Area
EUR: Euro (currency)
KMF: Comoro franc (currency)
LGD: Loss Given Defaut
LLP: Last Liquid Point
OECD: Organisation for Economic Co-operation and Development
RAVC: Risk Adjusted Value of Collateral
RFR: Risk Free Rate
SCR: Solvency Capital Requirement
SCR_{EQ}: SCR for Equities see *Equity Risk Sub-Module (Article 168)*
SCR_{IR}: SCR for Interest Rate see *Interest Rate Sub-Module (Articles 164 to 166)*
SCR_{SPREAD}: SCR for Spread see *Spread Risk Sub-Module: General*
SCR_{PR}: SCR for Property, downward shock of 25%
SCR_{CONC}: SCR for Concentration see *Market Risk Concentrations Sub-Module (Articles 183 to 187)*
SCR_{FX}: SCR for Currency see *Currency Risk Sub-Module (Article 188)*
RAROC: Risk Adjusted Return on Capital
SPV: Special Purpose Vehicule
UFR: Ultimate Forward Rate
XOF: CFA franc BCEAO, West African CFA Franc (currency)
XAF: CFA franc BEAC, Central African CFA Franc (currency)

VIII – Index

IX – Reference

- EIOPA website :
    - https://eiopa.europa.eu/
- Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II):
    - CELEX:32009L0138
    - http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0138
- Consolidated directive 2009/138/EC : French and English version as end of march 2016 :
    - CELEX:02009L0138
    - http://eur-lex.europa.eu/legal-content/FR-EN/TXT/?uri=CELEX:02009L0138-20150331
- Commission Delegated Regulation (EU) 2015/35 of 10 October 2014 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II) Text with EEA relevance
    - CELEX:32015R0035
    - http://eur-lex.europa.eu/legal-content/EN-FR/ALL/?uri=CELEX:32015R0035
- "Infrastructure Amendment" : Commission Delegated Regulation (EU) 2016/467 of 30 September 2015 amending Commission Delegated Regulation (EU) 2015/35
    - CELEX:32016R0467
    - http://eur-lex.europa.eu/legal-content/EN-FR/TXT/?uri=CELEX:32016R0467

Natixis Asset Management

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