Volatility adjustment under the loop

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Abstract

Under a Solvency II balance sheet, the liabilities are valued at Market Value (i.e. the Best Estimate of the Liabilities plus risk margin). The Best Estimate of the Liabilities are calculated by discounting future cash-flows using the risk-free rate (RfR).

On top of this risk-free rate, EIOPA allows under specific circumstances to add a “volatility adjustment” for long-term guarantees insurance products. This Volatility Adjustment (VA) aims to dampen irrational market developments that would result in unjustified credit spreads. More concretely, the purpose is to moderate the effect of deteriorating bond prices as a result of low market liquidity or as a result of an exceptional (non-credit related) widening of bond spreads.

Each month, EIOPA publishes the VA, which is calculated based on a pre-defined reference investment portfolio, representing an average European insurer.

While the use of a generic representative asset portfolio and the resulting adjustment on the liability discounting curve are desirable ensuring convergence in the calculation of the Solvency II ratio under pillar 1 quantitative requirements, it would be possible to tailor the approach as part of pillar 2 system of governance to make it fully up-to-date and insurer specific resulting in an “**Own VA assessment**”:

- We observe that, throughout Europe, the composition of insurer’s asset portfolios can differ quite significantly. From a risk management perspective, it would be more appropriate to start from an individual insurer’s asset portfolio and extract the non-default related fluctuations in market value of assets;
- If the VA is added towards the liabilities’ discounting curve, it is necessary to link assets and liabilities by taking into account the duration gap and the level at which liabilities are covered by the fixed income portfolio.

We introduce an alternative approach for determining the Volatility Adjustment which aims to meet the above objectives while respecting the VA purpose and the developments performed so far at EIOPA level.

We derive an expression for the VA by considering the monetary impact on the assets in the form of an amount to be added to the Market Value of assets (or subtracted from liabilities). This monetary amount is subsequently turned into an additive spread on the discounting curve, in order to compare this “Own VA” with EIOPA methodology.

In this article we also address some technical data aggregation issues regarding EUR government bonds, which become more prevalent in a negative interest rate environment and we propose a pragmatic solution in order to avoid negative liquidity spreads.

We finally illustrate this new “own VA” methodology on a concrete example and compare both approaches under several scenarios. This allows us evidencing the proper risk management incentives offered by the “own VA”.

The scheme below illustrates the underlying concepts of the suggested VA approach:

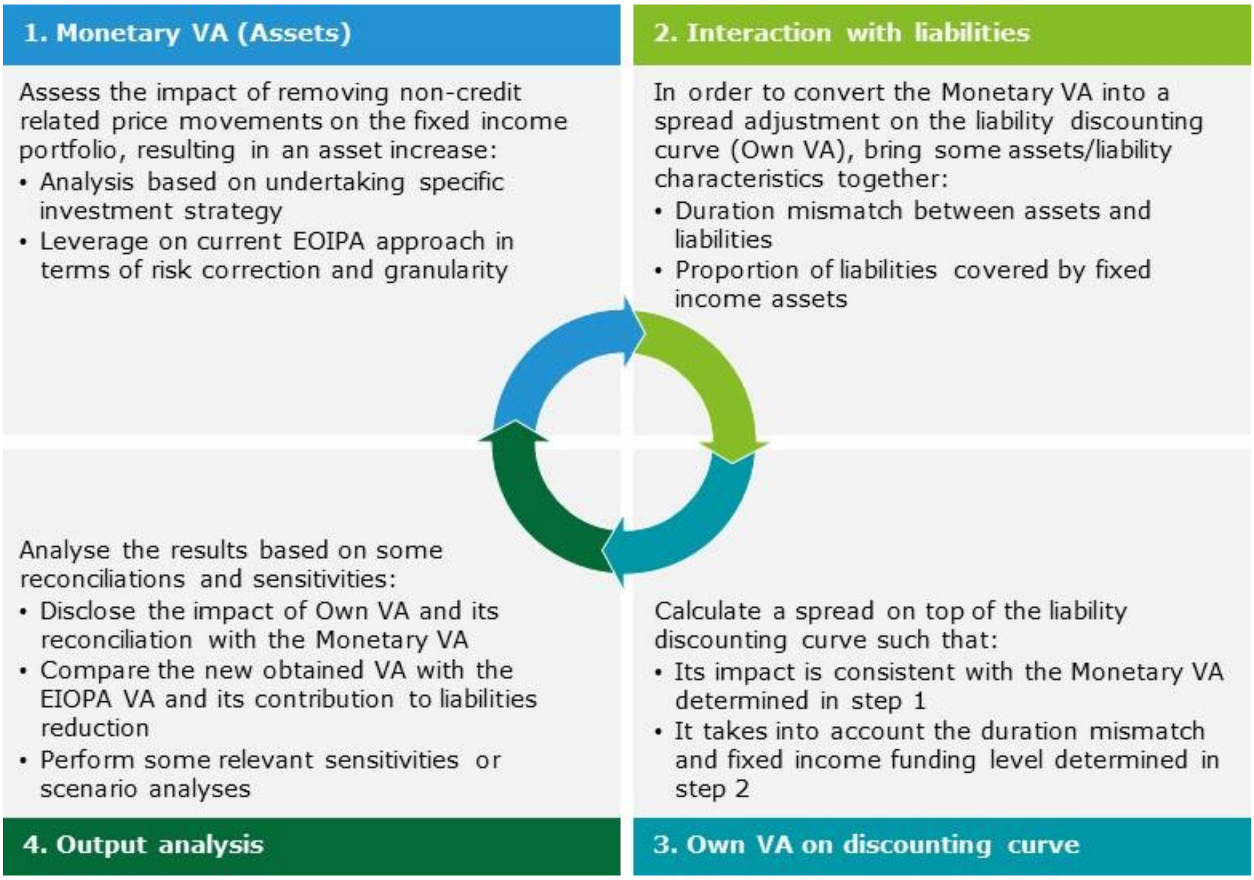

Figure 1: Underlying concepts of the own VA approach.

This new methodology has the very advantage of leveraging on the current EIOPA VA approach while promoting a better risk management based on market data and updated undertaking specific assets and liabilities. This also further supports the objective of avoiding excessive volatility in Solvency II and stabilizing capital resources for insurers both from a supervisor and management perspective.

Structure of this Paper

After describing the volatility adjustment (VA) calculation methodology, we evidence the necessary steps to translate the current approach into an appropriate risk management tool.

Those steps include solving basis risk[1], duration gap, fixed-income funding level and data aggregation issues. From those mismatches, one could derive wrong incentives when using the standard VA as a basis for risk management.

In an attempt to achieve the above objective, we propose a new approach where the adjustment would be calculated on the asset side in monetary terms before converting this impact into a spread on the discounting curve depending on the insurance liabilities.

Finally, we compare both approaches and test them under central and alternative scenarios. We also perform some alternative analyses under both approaches where the VA would be calibrated at Belgian level.

Before concluding, we list some possible further developments of this "Own VA" under Solvency II and potential synergies with IFRS17.

What is the volatility adjustment?

In order to value the Best Estimate of an insurer liabilities (BEL) under Solvency II, the future expected cash-flows of long-term guarantee products are discounted using the risk-free rates plus an eventual volatility adjustment in case of stressed fixed-income markets as calculated by EIOPA.

The risk-free rates are published monthly by EIOPA and are essentially based on swap rates (for EUR these are 6 month EURIBOR swap rates) up until the Last Liquid Point (LLP), which is set at 20 years for EUR. Beyond the LLP, the rate curve is extrapolated by converging to an Ultimate Forward Rate (UFR). On top of this risk-free rate, EIOPA allows under specific circumstances to add a "volatility adjustment" (as a fixed spread[2]), which is aimed at dampening the "own funds' artificial volatility" that is caused by the stressed fixed-income financial markets.

This "artificial volatility" comes from non-default related changes in market values (MV) of assets; the market value of the bond can vary due to market movements other than a default risk (most predominantly liquidity changes). However, since insurance companies have long-term guarantees and aim to hold their assets accordingly, Solvency states that their own funds (and their required capital calculation) should not be affected by those temporary changes. Since their assets in the Solvency II (SII) balance sheet are quoted at market value, SII allows for an adjustment to their Best Estimate Liabilities calculation instead, by applying an additive spread, the volatility adjustment, to the discount rate.

The VA calculation methodology[3,4]

For each generic bond portfolio (government and corporate), the VA calculation consists of two components: a spread component and a risk-correction component. For the government bond portfolio, these two components (spread and risk-correction) are calculated for each different

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[1] This is caused by the difference in composition between the reference portfolio used by EIOPA, and an individual insurer's portfolio.

[2] This fixed spread acts as a parallel shift until the LLP before applying the extrapolation, i.e. the VA has an impact over the full discounting curve.

[3] Source: Technical documentation of the methodology to derive EIOPA's risk-free interest rate term structures, 20 December 2017. Please note that this description is limited to the currency VA and does not cover the country specific increase of VA.

[4] EIOPA has provided an example calculation spreadsheet for the VA, which illustrates the methodology set out in this section (See: https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii-technical-information/risk-free-interest-rate-term-structures).

country in the portfolio. For the corporate bond portfolio, EIOPA calculates the spread and risk-correction for both non-financials and financials, and for each different rating class.

- The **spread component** aims at calculating a representative bond spread for the generic bond portfolio. The bond spread equals the difference between the bond market yield, and the risk-free rate[5].
- The **risk-correction component** aims at capturing the credit-related component of the bond spread:
  - For the government bond portfolio, this risk correction corresponds to 30% of the long-term average spread (LTA (i.e., $Risk\ Corr_{gov} = \max(30\% \cdot LTA\ spread\ _{gov}, 0)$;
  - For the corporate bond portfolio, the risk-correction equals to the maximum between 35% of the long-term average of the representative corporate bond spread, and the sum of the Probability of Default (PD) and Cost of Downgrade (CoD) (i.e., $Risk\ Corr_{corp} = \max(35\% \cdot LTA\ spread_{corp}\ , PD + CoD)$[6].

One can think of 30% of the Long Term Average Spread (LTA) or PD + CoD as representing the credit component of the spread. Therefore, the "credit risk adjusted spread" (=spread – 30%*LTAS) represents the proportion of the bond spread that stems from non-credit related market movements. As was illustrated by the 2008 financial crisis, the key component of the credit spread is related to the probability of default of the counterparty. The main non-credit related market movement is the liquidity component of the spread. Throughout the text, we shall hence use the terms "credit risk adjusted spread" and "liquidity spread" interchangeably.

A portfolio-level bond spread and risk correction are calculated as follows:

- A single cash-flow is projected for each model bond according to the duration of the model bond and using as capitalization rate the market yield. This means a cash-flow projection of 1€ with the duration and market yield of each model bond;
- The projection of single cash-flows for each model bond is repeated but using as capitalization rate the basic risk-free rate;
- A third projection is necessary but using this time, as capitalization rate, the market yield reduced with the risk correction.

Based on the cash-flows calculated above, weighted by the relative market value of the model bond in the generic portfolio, EIOPA calculates three different internal effective rates (IER). These correspond to the single discount rate that, when applied to the cash-flows calculated above, results in a value that is equal to the aggregated value of the whole portfolio. For the government bond portfolio, and for the corporate bond portfolio, one then has three internal effective rates:

$IER_{yield\ market}$: the generic bond-portfolio (government or corporate) market yield;

$IER_{yield\ RFR}$: the corresponding bond-portfolio risk-free rate;

$IER_{yield\ corrected}$: the generic bond-portfolio (government or corporate) risk-corrected market yield.

At the full portfolio level (government plus corporate), EIOPA then calculates an "aggregated" spread and risk-correction as follows:

Portfolio level spread:

- The government bond spread is calculated as: $Spread_{gov} = IER_{yield\ market-gov} - IER_{yield\ RFR-gov}$
- The corporate bond spread is calculated as: $Spread_{corp} = IER_{yield\ market-corp} - IER_{yield\ RFR-corp}$
- The portfolio spread is then given by:

[5] The risk-free rate here refers to the EIOPA risk-free rate for each specified currency.

[6] The coefficients are determined in Article 77c(2) of Directive 2009/138/EC, and are based on observations in financial markets.

$$\text{Spread}_{\text{portfolio}} = \text{w}_{\text{gov}} \cdot max(\text{Spread}_{\text{gov}}, 0) + \text{w}_{\text{corp}} \cdot max(\text{Spread}_{\text{corp}}, 0), \quad (1)$$

where w_{gov} and w_{corp} are some generic European portfolio weights published by EIOPA.

Risk Correction calculation:

- The government bond portfolio Risk-Correction is calculated as:

$$RC_{gov} = IER_{yield\ market-gov} - IER_{yield\ corrected-gov}$$

- The corporate bond portfolio Risk-Correction is calculated as:

$$RC_{corp} = IER_{yield\ market-corp} - IER_{yield\ corrected-corp}$$

- Then, a portfolio "Risk Correction" is calculated as:

$$\text{RC}_{\text{portfolio}} = \text{w}_{\text{gov}} \cdot max(\text{Risk Corr}_{\text{gov}}, 0) + \text{w}_{\text{corp}} \cdot max(\text{Risk Corr}_{\text{corp}}, 0), \quad (2)$$

where w_{gov} and w_{corp} denote the proportion of government bonds and corporate bonds in the portfolio.

The final volatility adjustment is then equal to 65% of the risk-adjusted spread:

$$\text{VA} = 65\% \cdot (\text{Spread}_{\text{portfolio}} - \text{Risk Corr}_{\text{portfolio}}) \quad (3)$$

Necessary steps for an "Own VA assessment"

Each month, EIOPA publishes the VA, which is calculated based on a pre-defined reference portfolio, representing an average European insurer, and thus differences in asset portfolios, investment strategies and durations are not reflected within the VA calibrated at EU level. We identify the following 4 deficiencies with EIOPA calculation to be solved to make the VA "risk management compliant" with fully up-to-date data at insurer level:

- **Basis Risk**: significant differences can be observed between EIOPA generic portfolio and actual investment portfolio – we note that this is only partially addressed by the introduction of the country specific VA;
- **Duration mismatch**: the duration gap between assets and liabilities seems to be implicitly included in the above 65% ratio but can deviate significantly from the insurer situation and is rather fixed over time as it is defined in article 77d of the Solvency II directive;
- **Funding level of liabilities by fixed income assets**: EIOPA VA calculation captures the asset distribution within the portfolio and the level at which the liabilities are covered by the fixed income portfolio[7] by defining the representative portfolio and the related corporate and government weights. Next to the basis risk at insurer level, we note that those weights are updated once the aggregated yearly reporting templates of the previous year are available at EU level. This could result in a potential outdated situation at calculation date if the conditions would have changed significantly in the meanwhile;
- **Data aggregation issues on EUR government bonds:** the government bond yields and LTA used in EIOPA VA calculation are the same for all EURO bonds. These yields ought to differ by country, in order to adequately capture differences in liquidity between different government bonds. Applying EIOPA methodology at a more granular level, however, leads to negative liquidity spreads as it is the case under the country specific VA.

Basis risk and duration gap issues

In his recent article "Amending the Solvency II VA to promote good risk management[8]", Richard Plat identifies some pitfalls of the current EIOPA VA methodology.

[7] I.e. the relative size of the bond portfolio compared to the liabilities.
[8] Dr. Richard Plat AAG RBA, "Amending the Solvency II VA to promote good risk management", December 2016.

He made a study on the own funds evolution of a fictive insurer holding the representative Dutch portfolio over 2000-2015 where the current VA approach would have been used. Surprisingly, the largest historical profit would have been observed during 04/2008 and 03/2009, i.e. during the very peak credit crisis which is against the EIOPA objective of avoiding artificial volatility in the insurance sector.

Two factors explain this abnormal situation:

1. basis gap: the EU representative bond portfolio appears to be more aggressive than the Dutch bond portfolio;
2. duration gap: the VA is applied to the full term of liabilities whereas the asset duration is shorter.

The resulting VA would be too high and applied for too long reducing the liabilities in an undue high proportion compared to the observed market correction on the investment portfolio.

The author then proposes a new methodology for calculating EIOPA VA:

"*Define the VA on the same level of granularity as the risk correction (per maturity for each government and for each combination of corporate category, rating and maturity) and let each insurer map their own bond portfolios to these combinations of categories. The resulting VA should then only be applied to the duration of the assets."*

We translate this requirement as follows: "Generate a term-structure for the VA at the most granular level before ensuring an application that is consistent with the asset composition".

Funding level of liabilities by fixed income assets

The VA aims at capturing the non-credit related component (predominantly liquidity) of the fixed income portfolio. Since the VA is applied to liability cash-flows, the weights of the representative portfolios capture the proportion of long-term liability cash-flows that are covered by fixed-income assets at EU level.

EIOPA revises yearly the representative portfolios based on data reported by European insurers to their national supervisors as part of their annual supervisory reporting. The process is quite long such that there is a time lag between the asset data used for calibration purposes and their effective use in the VA. As an illustration, the updated portfolio applicable as from end-March 2018 is part of the 2017 annual reporting with insurance market data as of end 2016.

In case of significant deviation at EU level between the two dates in terms of funding level, asset allocation within fixed-income or relative market value, the inferred data underlying the VA calculation could differ significantly from the recalibrated values at date of calculation. This adds a timing issue on top of the EU-insurer basis risk.

Data aggregation issues

A further deficiency we perceive in EIOPA approach for risk management purposes is the aggregated treatment of the EUR government bonds. Indeed, for each government bond denominated in EUR, the market yield and LTA correspond to the same aggregated EUR yield (ECB curve) and LTA respectively. One frequently used measure of market liquidity is the secondary market trading volume. As an illustration, the Spanish and German government bond markets showed in 2016 an average daily turnover of around 16 bn EUR, whereas for Italy and Belgium this was only 5 bn and 7 bn EUR respectively. Furthermore, in 2016, Portuguese and Greek government bonds had an average daily trading volume below 1 bn EUR[9]. This illustrates a clear

[9] Source: Association for Financial Markets in Europe (AFME), "Government Bond Data Report – European market data update", Q4 2016.

difference in liquidity between different EUR government bonds, which we believe should be reflected in the Currency VA.

In the Country VA calculation, EIOPA does make a distinction between country specific yields. This approach is a better reflection of the underlying liquidity components given the observed differences in traded volumes for EUR government bonds. The way in which it is executed in EIOPA Country VA calculations, however, reveals a significant flaw, namely, the occurrence of negative liquidity spreads for short and sometimes even mid-term duration. The reason for the occurrence of negative liquidity spreads in EIOPA methodology is due to the fact that, in recent years, the yields of highly rated government bond yields have dropped below the EIOPA risk-free rate. In case of observed negative liquidity spreads, this could be remediated by assessing the LTAS as spreads on top of the OIS rate rather than as spreads on top of the EIOPA rate, and subsequently taking into account the OIS-EIOPA basis when determining the credit component of the bond spread.

Other than the use of a generic EUR bond yield versus a government specific bond yield, the calculation methodology of the Country and Currency VA is the same. The use of an aggregated EUR government bond yield in the Currency VA calculation, however, masks the aforementioned flaw.

Appendix A explains in more detail how such negative liquidity spreads can occur and their impacts on the Country VA. In addition, we propose an alternative methodology where the OIS rate is used as basis for the LTA calculations.

A new approach to calculate the VA as part of the risk management system

In order to solve the abovementioned issues from a risk management perspective, we introduce a new approach starting from the actual assets composition covering the Best Estimate of long-term insurance liabilities[10] where the risk-corrected spread is derived at the most granular level resulting in an increase in fixed assets value ("Direct Asset Approach"). This first step solves the basis risk.

We then convert this monetary adjustment into a spread to be added to the EIOPA curve depending on the relative duration of assets and liabilities and the proportion of liabilities funded by fixed income ("Spread conversion"). This second step solves the duration and fixed income funding level issues if one would still apply an adjustment to the liability side expressed as a shift to the EIOPA curve.

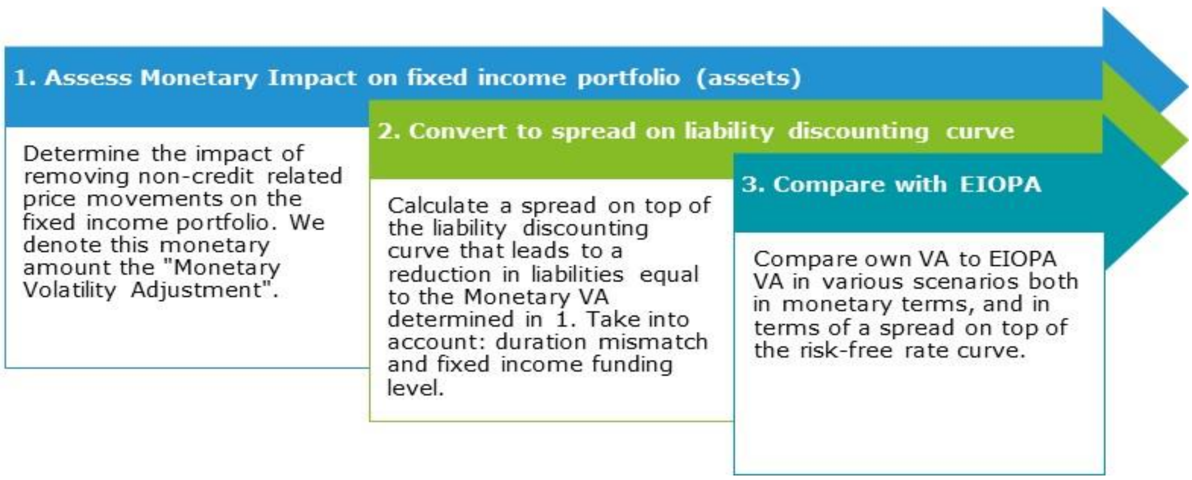

Figure 2: The three steps in the suggested VA approach (Direct Asset Approach).

[10] Assets covering Unit-linked liabilities and liabilities subject to the Matching Adjustment are excluded from those assets in line with the VA application scope.

The Direct Asset Approach: deriving the monetary impact of the VA

Suppose we have a given reference bond portfolio. We want to assess the actual impact on the market value of assets (in monetary terms) of removing the non-credit related spreads. That is, for each bond in the portfolio covering illiquid liabilities, we want to assess the value of removing the liquidity spread. The Direct Asset Approach assesses the volatility adjustment on the bond portfolio directly, rather than by means of an adjustment to the discounting of liabilities.

The liquidity spread can be determined in a number of different ways. Given the comprehensive data sets provided by EIOPA, we leverage as much as possible their approach. In a similar way to EIOPA, we make a distinction between government bonds and corporate bonds.

For ***government bonds***, we determine the liquidity spread for each different country in the government bond portfolio[11]

$$\text{Liquidity Spread}_{\text{country}} = max(\text{Spread}_{\text{gov}}, 0) - max\big(30\% \cdot \text{LTA spread}_{\text{gov}}, 0\big) \tag{4}$$

For ***corporate bonds***, we make a further distinction between the investment type (Financial or Non-Financial) and the rating grade[12]:

$$\begin{aligned}&\text{Liquidity Spread}_{\text{rating,type}} = max\big(\text{Spread}_{\text{rating,type}}, 0\big)\\ &- max(35\% \cdot \text{LTA spread}_{\text{rating,type}}, \text{PD}_{\text{rating,type}} + \text{CoD}_{\text{rating,type}})\end{aligned} \tag{5}$$

Removing the liquidity spread from the bond portfolio would correspond to an approximate increase in market value equal to[13]:

- For **government bonds**:

$$\sum \text{Liquidity Spread}_{\text{country}} \cdot \text{Duration}_{\text{country}} \cdot \text{Total CF}_{\text{country}}\,, \tag{6}$$

  Where $Total\ CF_{country}$ denotes the sum of all the cash-flows (undiscounted), of all the government bonds from country "*country"* and where the $\text{Duration}_{\text{country}}$ is the duration weighted by Market Value for the government bonds held with "*country"*[14].

- For ***corporate bonds***:

$$\sum \text{Liquidity Spread}_{\text{rating and type}} \cdot \text{Duration}_{\text{rating and type}} \cdot \text{Total CF}_{\text{rating and type}} \tag{7}$$

  where $Total\ CF_{rating\ and\ type}$ denotes the sum of all the cash-flows (undiscounted), of all the corporate bonds with rating "*rating"* and investment type "*type"* and where the $\text{Duration}_{\text{rating and type}}$ is the duration weighted by Market Value for the corporate bonds held with "*rating"* and "*type".*

[11] We point out $\text{Spread}_{\text{gov}}$ and $\text{LTA spread}_{\text{gov}}$ have maturity equal to the average duration of the country's government bonds in the asset portfolio. Thus, the liquidity spread for each country's government bonds is dependent on the average duration in the asset portfolio.

[12] We point out the $\text{Spread}_{\text{rating and type}}$, $\text{LTA spread}_{\text{rating and type}}$, $\text{PD}_{\text{rating and type}}$ and $\text{CoD}_{\text{rating and type}}$ have maturity equal to the average duration of the related assets in the portfolio.

[13] Here we use the "single cash flow assumption": i.e. $MV \approx total\ CF * \exp\big(-Duration * (rfr + spread)\big)$, where $spread$ captures both liquidity and credit. It follows that:
$\Delta MV \approx total\ CF * \Delta \exp\big(-Duration * (rfr + spread)\big) \approx -total\ CF * Duration * \Delta\,(rfr + Spread)$
Removing the liquidity spread while keeping constant the rfr and credit component of $spread$, we then have that: $\Delta\,(rfr + Spread) = \Delta\,(rfr + Credit\ Spread + Liquidity\ Spread) = (0\text{-}Liquidity\ Spread)$ such that: $\Delta MV \approx\ total\ CF * Duration * Liquidity\ Spread.$

[14] In the case where marking to market is not possible (i.e. no deep and liquid market), one would require the liquidity spread for the VA to be consistent with its mark-to-model counterpart. For example; if the fair value model applies a liquidity spread of X% for a particular asset (= Yield – RfR – Credit Spread), then this liquidity spread should also be used in the associated VA calculation. The inclusion of the VA will then remove the impact this liquidity spread. In other words, one could set liquidity spreads for mark-to-model assets equal to zero, provided one does so as well in the VA calculation.

Adding amounts (6) and (7), gives the monetary impact of removing the non-credit related spreads from the assets at time t=0 (i.e., the instantaneous P&L gain that the insurer would incur by removing all future non-credit related spreads in their valuation). We define this amount the "***Monetary Volatility Adjustment***".

The **best approach for incorporating the VA** would be to simply perform the above analysis with the insurer's portfolio composition (government bonds/corporate, country, financial non-financial, rating, durations…). The resulting "Monetary VA" should then be added to the MV of assets (or subtracted from the Best Estimate Liabilities – BEL), and no adjustment would have to be performed on the discounting curve.

Converting the monetary impact into a spread on the discounting curve

Including the volatility adjustment as an absolute monetary value (rather than as a spread on the discount curve), is the most straight forward and consistent way to remove non-credit related market value changes from the asset portfolio.

Nonetheless, if one really wants to explicitly take into account the VA in the form of an additive spread on the discounting curve used to calculate the BEL as it is the case today, one would have to calibrate the spread on top of the EIOPA curve that corresponds to a decrease in liabilities equal to the Monetary VA. EIOPA choses this approach as the observed asset market values should in theory not be adjusted whereas the non-quoted liabilities can be adjusted taking into account the long-term pattern of some insurance liabilities.

This conversion is however not straightforward and setting up a solver to calculate this spread could be rather cumbersome. However, below we describe a generic proxy that bypasses the need for a solver by the application of a Taylor expansion. We first set out the assumptions and limitations regarding this proxy:

- **Assumption 1:** We can approximate the liabilities cash-flows by a single cash-flow at the liability duration. Mathematically;

$$\sum_i \frac{Cash\ Flow\ Liab_i}{(1+RfR_i+VA)^{t_i}} \approx \frac{\sum_i Cash\ Flow\ Liab_i}{(1+RfR_{duration}+VA)^{dur\ L}}$$

  Here $Cash\ Flow\ Liab_i$ refers to the expected cash flow at time t_i.[15]

  This approximation holds true for relatively flat interest rate curves (rfr_i).

- **Assumption 2**: We require the risk-free rate and the VA to be sufficiently small so that we can make limit the Taylor expansion to the first term:

$$(1+RfR_{duration}+VA)^{-duration} \approx 1 - duration \cdot (RfR_{duration}+VA)$$

  In particular, we require:

$$|duration \cdot (RfR_{duration}+VA)| \ll 1$$

Given the current flat and low interest rate environment, these two approximations work extremely well. However, even in the case of a higher interest rate environment, the approximations remain adequate[16].

[15] In the case of non-deterministic liability cash flows, the expected cash flow would be either provided by an economic scenario generator or a central equivalent scenario.

[16] Given the EIOPA risk free rate and VA on 31/12/2017, the relative error of this approximation would equal 0.0%, 0.4%, 1.9%, and 4.6% for durations 5Y, 10Y, 15Y and 20Y respectively. Note that, in case of non-negative risk-free rates, $1 - duration \cdot (RfR_{duration}+VA)$ is smaller than $(1+RfR_{duration}+VA)^{-duration}$, yielding a prudent approximation to the VA.

Let BEL_{RfR} denote the Best Estimate of Liabilities, discounted with the EIOPA risk-free rate (without VA). We would then require the BEL_{VA}, the Best Estimate of Liabilities discounted with the EIOPA risk-free rate plus VA, to satisfy;

$$\mathrm{BEL_{VA}} = \mathrm{BEL_{RfR}} - \text{Monetary VA}. \tag{8}$$

Let denote by $Total\ CF\ Liab$ the sum of all future expected cash-flows – not discounted (equivalently, the BEL where everything was discounted with Discount Factor 1)[17]. We have that

$$\mathrm{BEL_{RfR}} \approx \text{Total CF Liab} \cdot (1 + \mathrm{r_{dur\,L}})^{-\mathrm{dur\,L}} \approx \text{Total CF Liab} \cdot (1 - \mathrm{dur\,L} \cdot \mathrm{r_{dur\,L}}) \tag{9}$$

where $dur\ L$ denotes the duration of the liabilities, and $r_{dur\ L}$ denotes the EIOPA risk-free rate at maturity $dur\ L$[18]. Similarly we have that

$$\begin{aligned}\mathrm{BEL_{VA}} &\approx \text{Total CF Liab} \cdot (1 + \mathrm{r_{dur\,L}} + \mathrm{VA})^{-\mathrm{dur\,L}} \approx \text{Total CF Liab} \cdot \big(1 - \mathrm{dur\,L} \cdot (\mathrm{r_{dur\,L}} + \mathrm{VA})\big) \\ &\approx \mathrm{BEL_{RfR}} - \mathrm{VA} \cdot \mathrm{dur\,L} \cdot \text{Total CF Liab},\end{aligned} \tag{10}$$

where in the last equality we used equation (9). Combining equations (8) and (10) we obtain:

$$\text{Monetary VA} \approx \mathrm{VA} \cdot \mathrm{dur\,L} \cdot \text{Total CF Liab}. \tag{11}$$

We hence have that:

$$\mathrm{VA} \approx \frac{\text{Monetary VA}}{\mathrm{dur\,L} \cdot \text{Total CF Liab}}, \tag{12}$$

or equivalently:

$$\mathrm{VA} \approx \frac{\sum_{\mathrm{i}} \text{Liquidity Spreads}_{\mathrm{i}} \cdot \text{Duration}_{\mathrm{i}} \cdot \text{Total CF Bonds}_{\mathrm{i}}}{\mathrm{dur\,L}} \cdot \frac{1}{\text{Total CF Liab}}, \tag{13}$$

where the sum is taken over all different countries (for government bonds) and all different rating classes and investment types (for corporates) in the bond portfolio.

If we extract an average yearly spread LS^* for the global bond portfolio duration dur_B, i.e.,

$$LS^* \cdot\ dur_B = \frac{\sum_i Liquidity\ Spreads_i \cdot Duration_i \cdot Total\ CF\ Bonds_i}{\sum_i Total\ CF\ Bonds_i}, \tag{14}$$

we can rewrite equation (13) as follows:

$$VA \approx LS^* . \frac{dur_B}{dur_L} . \frac{Total\ CF\ Bonds}{Total\ CF\ Liab}, \tag{15}$$

where, $Total$ CF Bonds $= \sum_i Total\ CF_i$, equals the (undiscounted) sum of all future cash-flows stemming from the bond portfolio. We point out here that dur_B denotes the average duration weighted by total bond cash flows and not market values.

[17] To take into account optionalities (e.g. profit sharing, lapses, etc.), we suggest using as Total CF Liab, the cash flows stemming from a central scenario.

[18] Note that the first approximation in (9) is exact for when the expected liability cash-flows consist of one single cash-flow at time $dur\ L$.

Since non-fixed income assets have a zero duration, the total asset duration is the bond duration weighted by the proportion of fixed income in the total investment portfolio w_B:

$$\mathrm{dur_A} = \mathrm{w_B} . \mathrm{dur_B} \tag{16}$$

The following relationship links the expected impact of VA on the liabilities versus the impact of the average yearly spread on assets (LS^*):

$$\mathrm{VA} \approx \mathrm{LS}^* . \frac{\mathrm{dur_A}}{\mathrm{dur_L}} . \frac{\text{Total CF Bonds}}{\mathrm{w_B} * \text{Total CF } Liab} \tag{17}$$

Next to the basis gap of an EU representative bond portfolio versus the insurer portfolio and the related aggregation issues, we identify 2 adjustment factors in line with proper risk management:

- The VA should be related to the duration of the assets. If we want to apply it to the whole curve, the LS should be adjusted by the quotient of the durations;
- The funding level of liabilities by fixed income should also be taken into account.

Comparison with EIOPA VA definition

Defining $Liq\ Spread_{gov}$ and $Liq\ Spread_{corp}$ as being the weighted average bond liquidity spreads for government and corporate bonds respectively (weighted by $\mathrm{Duration_i} \cdot \text{Total CF Bonds}_\mathrm{i}$), we can re-write the VA expression (13) as:

$$\begin{aligned} VA \approx Liq\ Spread_{gov} \cdot weight_{gov} \cdot Dur\ Ratio_{gov} + \\ Liq\ Spread_{corp} \cdot weight_{corp} \cdot Dur\ Ratio_{corp} \end{aligned} \tag{18}$$

Where we have introduced:

$$weight_{gov} = \frac{Total\ CF\ Government\ Bonds}{Total\ CF\ Liab}, \qquad Dur\ Ratio_{gov} = \frac{Avg\ duration\ govies}{dur\ L}$$

and

$$weight_{corp} = \frac{Total\ CF\ Corporate\ Bonds}{Total\ CF\ Liab}, \qquad Dur\ Ratio_{corp} = \frac{Avg\ duration\ corporates}{dur\ L}$$

Note that equation (18) very much resembles the definition of the VA given by EIOPA in equation (3), which we can write under the form:

$$\mathrm{VA} = \mathrm{w_{gov}} \cdot \overline{Liq\ Spread_{gov}} \cdot 65\% + \mathrm{w_{corp}} \cdot \overline{Liq\ Spread_{corp}} \cdot 65\%, \tag{19}$$

with:

$\overline{Liq\ Spread_{gov}} = \max(Spread_{gov}, 0) - \max(RC_{gov}, 0)$,

and

$\overline{Liq\ Spread_{corp}} = \max(Spread_{corp}, 0) - \max(RC_{corp}, 0)$.

The table below summarizes the main characteristics of both approaches:

Component	EIOPA VA	Monetary VA	Comments
Percentage of risk-corrected spread (application ratio)	65%	$Dur\ Ratio_{G/C} = \frac{Avg\ duration\ G/C}{dur\ L}$	This correction ratio captures the duration mismatch between assets and liabilities. In addition it captures the different duration characteristics of different fixed-income investments. A further correction could be considered to address any illiquidity discrepancy between assets and liabilities (see section on application ratio).
Aggregation from government/corporate category to VA: weight of government (G) /corporate bonds (C)	Ratio of market value of government and corporate bonds included in the reference portfolio at calculation date as published by EIOPA[19]. The weights do not add up to 100% as only fixed income is part of the representative portfolio to cover the Best Estimate of (re)insurance obligations denominated in that currency.	Proportion of fixed income funded level per category: $\frac{Total\ CF_{G/C}}{Total\ CF_{Liab}}$	Consistent aggregation rules based on duration and CF. Using CF rather than market value is likely to be more stable.
Aggregation from bond level to government/ corporate category	Proportion of asset market value weighted by asset duration. The resulting weight is taken into account when determining the Internal Effective Rate.	Duration multiplied by total CF per bond.	
Risk-adjusted spread	Determined at government bond /corporate bond portfolio level by the use of an Internal Effective Rate under 3 scenarios (market yield, risk-corrected market yield, risk free) to infer the spread and risk-corrected spread.	Determined at bond level before converting the monetary impact into a basis point adjustment to be added to the curve.	Higher granularity level: same data input but aggregation is performed at a later stage.

Table 1: Main characteristics of EIOPA VA versus Monetary VA.

The Swiss Solvency Test

Under the Swiss Solvency Test, no volatility adjustment is applied to the risk-free rate curve. The Swiss Financial Regulator, FINMA, argues that, despite an insurer's intention to hold their assets to maturity, this does not mean they are not exempt from liquidity risks. Indeed, in an extreme event, an insurance undertaking might have to sell their assets prematurely in order to cover their liabilities. In these extreme events, the insurance undertaking is heavily exposed to liquidity risks.

One important remark is that, under the Swiss Solvency Test framework, the risk-free rates for Swiss francs are based on government bond yields. This is in contrast with the EIOPA curves which

[19] We note that the representative asset portfolios were updated in December 2017, with application date as of end March 2018.

are based on swap rates (in particular, for CHF the 6M CHF Libor rate is used). Generally, under the SST framework, the rate curves are prescribed by FINMA, although the use of individual risk-free curves might be allowed, if an internal model is applied[20]. In addition, during an extraordinary phase of low interest rates, FINMA might permit risky interest rate curves.[21]

Since the SST CHF-curve is derived from government bond yields, it will implicitly take into account the liquidity spread of the underlying government bonds. In other words, if the government bond market suddenly becomes more illiquid, the discount rates would increase (due to an increase in liquidity spreads), leading to a decrease in Best Estimate Liabilities. As a result, the Own Funds are in some sense less sensitive to market changes in asset illiquidity. In this way, a certain form of the "VA" is in some sense already implicitly taken into account in the SST rate. Note, however, that the SST curve is based on liquid government bonds (for CHF), and therefore, the curve does not necessarily reflect the liquidity component of the bonds covering the liabilities, which could be less liquid.

The respective political and economic environment of the EU and Switzerland is however too different to infer any simplistic conclusion between the two approaches. This would indeed require a comprehensive analysis of both systems. We therefore limit ourselves to a high-level theoretical comparison.

An illustrative example

In this section, we illustrate the difference between the different VA approaches by means of an example.

We consider an insurer with an asset portfolio with market value 1 bn EUR. As representative asset portfolio, we use the generic Belgian portfolio composition provided by EIOPA on 31/12/2017. EIOPA prescribes the asset allocation between fixed income and non-fixed income, as well as:

- For government bonds
  - The composition of the bond portfolio across different countries;
  - The average duration of the bonds from each country[22].
- For corporate bonds
  - The composition of the bond portfolio across different rating classes and Financials/Non-Financials;
  - The average duration of the bonds from each above segment[23].

The duration of the full asset portfolio is 7 years.

Furthermore, we assume liabilities whose estimated (non-discounted) future cash-flows are equal to 1.1 bio EUR, with a duration of 16 years. At current market rates, the Best Estimate Liabilities (discounted at EIOPA rate without VA) is approximately 906 mio EUR[24]. The liability is designed such that the newly proposed approach (approach C in Table 2 below) yields the same VA as

[20] FINMA Circular 2017/3: "Swiss Solvency Test" mn 46f.
[21] "Verordnung über die Beaufsichtigung von privaten Versicherungsunternehmen" (Aufsichtsverordnung, AVO), art. 77.
[22] The average duration of the government bonds in our Belgian reference portfolio (weighted by market value) equals 9 years.
[23] The average duration of the corporate bonds in our Belgian reference portfolio (weighted by market value) equals 5 years.
[24] In this calculation, we assume that the liability cash-flows consist of a single payment at time = duration of liabilities (i.e. at 16 years). The discount rate is the EIOPA rate on 31/12/2017.

EIOPA VA approach based on Belgian portfolio weights (approach B in Table 2 below). Figure 3 below illustrates the fictitious market value balance sheet.

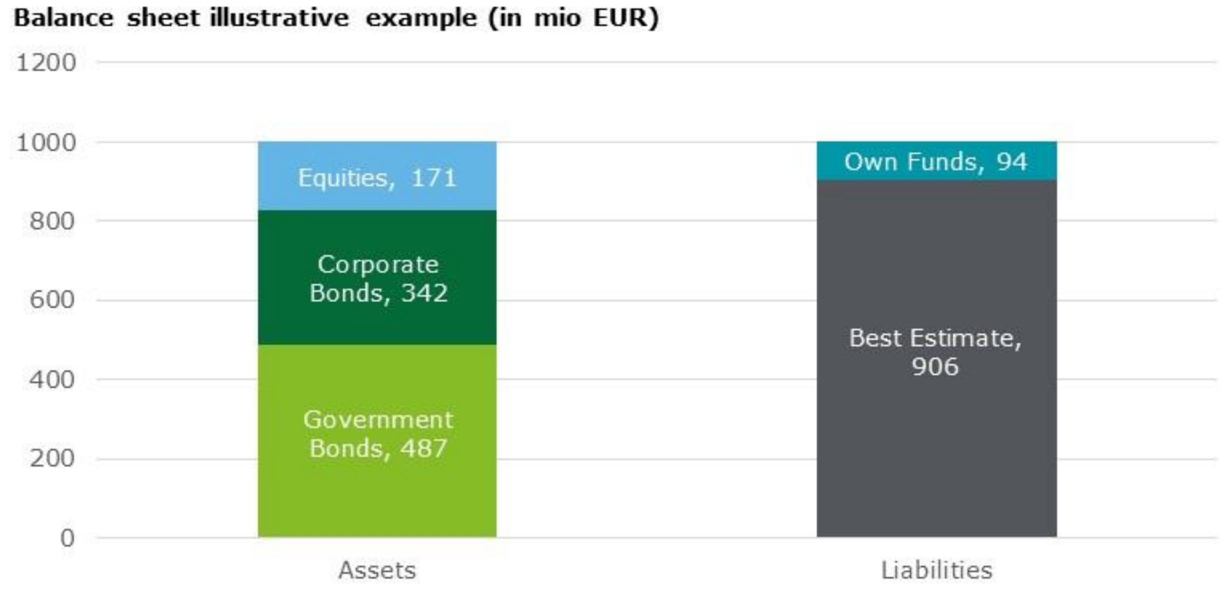

Figure 3: Balance Sheet of fictitious insurer.

Comparing the different VA approaches

In this assessment, we consider different approaches for calculating the VA. The different approaches cover:

- **Calculation Methodology**: this can either be EIOPA standardized VA methodology or the Direct Asset Approach leading to the "Own VA" outlined in the sections above.
- **The representative bond portfolio used**: Figure 4 below illustrates the asset distributions of the generic EUR portfolio and the Belgian government bond portfolio. Note that the Belgian government bond portfolio is the same portfolio as described in Figure 3.

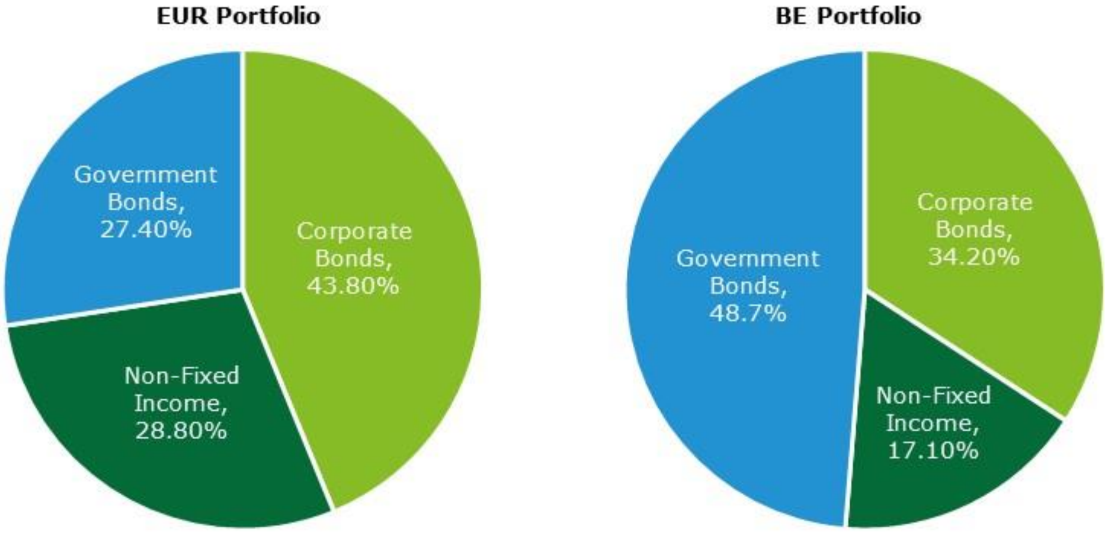

Figure 4: Asset distribution of EUR portfolio and Belgian portfolio (31/12/2017).

Table 2 below describes the different VA approaches considered in this analysis:

ID	Calculation methodology	Representative Bond Portfolio
A.	EIOPA Currency VA	EIOPA generic Euro Bond Portfolio
B.	EIOPA Currency VA	EIOPA generic Belgian Insurer's Bond Portfolio
C.	Direct Asset Approach	EIOPA generic Belgian Insurer's Bond Portfolio

Table 2: Different VA calculation approaches.

For the three approaches outlined above, we calculate both the VA, and the monetary impact this VA has for our example institution. Note that, in the Direct Asset Approach, the monetary impact corresponds with the Monetary VA defined above. The results are given in Table 3 below:

ID	Approach	VA (in BP)	Impact in mio EUR
A.	EIOPA Currency VA	4[26]	5.7
B.	EIOPA Currency VA (with Belgian portfolio)	6.5	9.3
C.	Direct Asset Approach (generic EUR bond yield)	6.5	9.3

Table 3: VA under different approaches (for Belgian example portfolio).

From the above table, we can already make a number of observations:

Firstly, as already mentioned above, we see here that, with our design of the insurer's characteristics, Approaches B and C yield the same VA.

Secondly, the differences observed when going from A to B, exposes the impact of Basis Risk (see section on Necessary steps for an "own VA assessment"); it quantifies the impact on the own funds of using a generic Belgian portfolio versus the generic European portfolio. For example, under method A, the Best Estimate of liabilities would equal 900.3 mio EUR (= 906-5.7), whereas under method B, the Best Estimate would be equal to 896.7 mio EUR (= 906-9.3). The generic Belgian portfolio would therefore be relatively slightly more liquidity sensitive than the European portfolio.

Analysis: illustrating the perceived deficiencies of EIOPA VA methodology for risk management purposes

Recall that in the section: Necessary steps for an "own VA assessment", we discussed a number of key steps in EIOPA approach to make the VA suitable for risk management purposes. The first adjustment, the impact of basis risk, has already been illustrated in the analysis above.

We continue by performing a sensitivity analysis on our insurer characteristics at Belgian level to compare EIOPA approach with the Direct Asset Approach (e.g. scenarios B and C are further studied). We consider the impacts of changing the following parameters at insurer level:

1. **The liability duration**: this illustrates the fact that EIOPA methodology does not adequately capture the actual duration mismatch between assets and liabilities.
2. **The proportion of the assets invested in fixed income instruments**: this addresses the impact of the funding level of liabilities by fixed income assets[27].

[25] In the above calculations, we make use of a generic EUR bond yield, which is applied to every government bond denominated in EUR (in alignment with the EIOPA currency VA approach). An alternative (and in our view more realistic) approach, would be to use the country-specific bond yield for each government bond, as discussed in the section "Data aggregation issues".

[26] Note that this value is exactly equal to the VA published by EIOPA on 31/12/2017.

[27] Note that changing the asset composition will implicitly also affect the asset duration (and hence the duration mismatch).

3. **Belgian BBB corporate bond liquidity spread**: here we assess the impact of a drop in liquidity in the BBB corporate bond market.

Sensitivity of liability duration

As was already discussed above, we would want the volatility adjustment to reflect the duration mismatch between assets and liabilities. Since the VA aims to capture the removal of non-credit related movements in assets, we would not want a change in liability duration to have a monetary impact.

In the Table 4 below we recalculated the VA of our example insurer under two scenarios, alongside our base scenario (duration of 16 years):

- A decrease in liability duration to 14 years
- An increase in liability duration to 18 years

We observe below that, in the direct asset approach (approach C), the volatility adjustment changes in such a way that the monetary impact of the VA remains invariant under the different scenarios. Only when asset and liability durations are the same (7 years in our example), should the full VA be recognised. When liabilities have a longer duration than assets, only a portion of the VA would apply.

	Monetary Impact of VA (mio EUR)			VA (in BP)		
Approach	Dur. = 14	Dur. = 16 (Base)	Dur. = 18	Dur. = 14	Dur. = 16(Base)	Dur. = 18
A.	5.2	5.7	6.2	4	4	4
B.	8.4	9.3	10.0	6.5	6.5	6.5
C.	9.3	9.3	9.3	7.2	6.5	6.0

Table 4: Impact of changing liability duration.

Sensitivity of funding level of liabilities by fixed income assets

In our Belgian example portfolio, the Fixed Income portfolio comprises 83% of the total assets. The funding level of liabilities by fixed income assets hence equals 91% (=MV Fixed Income Portfolio/Best Estimate Liabilities).

Table 5 below shows the VA of our example insurer in case of a relative decrease in fixed income coverage of liabilities by 40%[28]. The new coverage ratio (CR) would hence equal 55% (=60%*91%). This corresponds to an asset allocation to fixed income of 50% (down from 83%).

	Monetary Impact of VA (mio EUR)			VA (in BP)	
Approach	CR=55%		CR = 91% (Base)	CR = 55%	CR = 91% (Base)
	Absolute	Relative			
A.	5.7	0%	5.7	4.0	4
B.[29]	5.6	40%	9.3	3.9	6.5
C.	5.6	40%	9.3	3.9	6.5

Table 5: Impact of funding level of liabilities by fixed income assets.

[28] We have assumed that the total market value of the assets remains constant. The allocation within fixed income portfolio itself is also assumed to be constant.

[29] In approach B we have also imposed the new asset distribution in EIOPA VA calculation resulting in an updated representative asset portfolio.

First of all, we point out that this scenario is Belgian specific and hence is not expected to have an impact on the EU representative portfolio. We therefore have that this scenario does not affect the EIOPA currency VA in approach A.

Since the VA is aimed at capturing the non-credit related price movements of bonds, one intuitively would expect that a relative decrease in the number in bonds by 40% would equate to a decrease in 40% in monetary impact. Holding fewer bonds, would mean there is a lower monetary impact of removing liquidity, and this relationship should be linear. We observe that this is the case for both approaches B and C.

We point out that in approach B we updated the representative country bond portfolio provided by EIOPA to match the new asset distribution. Here we refer back to our assertion in the section on the "Funding level of liabilities by fixed income assets" regarding the time lag involved in EIOPA publishing the representative portfolio. In the example above we assumed a "fully reactive" EIOPA where the representative country asset portfolio is updated directly following changes in composition. In practice, however, one would have that in the case of a shock change in asset distribution at EU level, EIOPA approach would not capture any change in VA, nor in monetary impact (i.e., the shocked scenario under approach B would yield the same VA and monetary impact as in the base case, similarly to approach A).

Sensitivity of liquidity drop in BBB corporate bonds[30]

We consider the scenario of a sudden drop in liquidity in the BBB non-financial corporate bond market. We model this drop in liquidity by a sudden increase in the BBB non-financial corporate bond yield of 50 BP. Given that prior to the shock, 23% of the corporate bond portfolio consists of BBB non-financial corporate bonds, the shock would reduce the market value of the BBB non-financial corporate bonds by approximately:

$$\begin{aligned} &MV\ BBB\ non\ fin.Corp\ Bonds_{pre\ shock} - MV\ BBB\ non\ fin.Corp\ Bonds_{post\ shock} \\ &\quad \approx MV\ BBB\ non\ fin.Corp\ Bonds_{pre\ shock} \cdot 50\ BP \cdot duration \approx 23\% \cdot MV\ Corp\ Bonds \cdot 50\ BP \cdot 5 \\ &\quad \approx 23\% \cdot 342\ mio\ EUR \cdot 50\ BP \cdot 5\ \approx 2\ mio\ EUR \end{aligned}$$

In this scenario the market value change of 2 mio EUR is due to a change in liquidity, and hence we would want the VA to completely capture this change in Market Value. In other words, we would like the Own Funds to remain relatively stable in this temporary situation in order to avoid artificial volatility and procyclical effects.

We once again point out the time lag issue regarding EIOPA publishing the representative portfolio discussed in the section "Funding level of liabilities by fixed income assets". Given the sudden shock described in the scenario, we have assumed in the below impact assessments that the EIOPA representative portfolio weights remain unchanged by the shock (i.e. only the bond yields will be updated when calculating the EIOPA VA). We note, however, that the portfolio lag is not the key driver of the results below but the approach of calculating the VA impact on the liabilities. Indeed, even when we adjust the EIOPA portfolios to capture MV change due to the BBB yield shock, we obtain very similar results.

Table 6 below reveals the monetary impacts of the VA, whereas Figure 5 illustrates the change in Own Funds for the scenario under each approach. We observe that under the Direct Asset approach (approach C), the own funds remain practically unchanged due to the change in liquidity (which is desired)[31].

Approach B overshoots the desired monetary VA by 1.6 mio EUR (leading to a fictitious increase in Own Funds). This a consequence of the fact that EIOPA applies their VA to the liabilities and do not

[30] We consider here the case of corporate bonds only to avoid the issues explained previously w.r.t. data aggregation issues on government bonds. If those would be treated at individual country yield level, and the LTA would be calibrated such that no negative liquidity spreads arise (by e.g. using our proposed methodology discussed in Appendix A), the same conclusion would apply.

[31] Note that the small difference in own funds of 0.1 mio EUR is an approximation error coming from the Taylor expansion in equations (6) and (7).

directly take into account market value changes in their assets (a key driver of this being the duration mismatch between assets and liabilities). Similarly, approach A leads to an increase in own funds of 0.9 mio EUR.

	Monetary Impact of VA (mio EUR)		VA (in BP)	
Approach	Base	Shocked Yield	Base	Shocked Yield
A.	5.7	8.6	4	6
B.	9.3	12.8	6.5	9.0
C.	9.3	11.4	6.5	8.0

Table 6: Impact of changes in Belgian government bond liquidity spread.

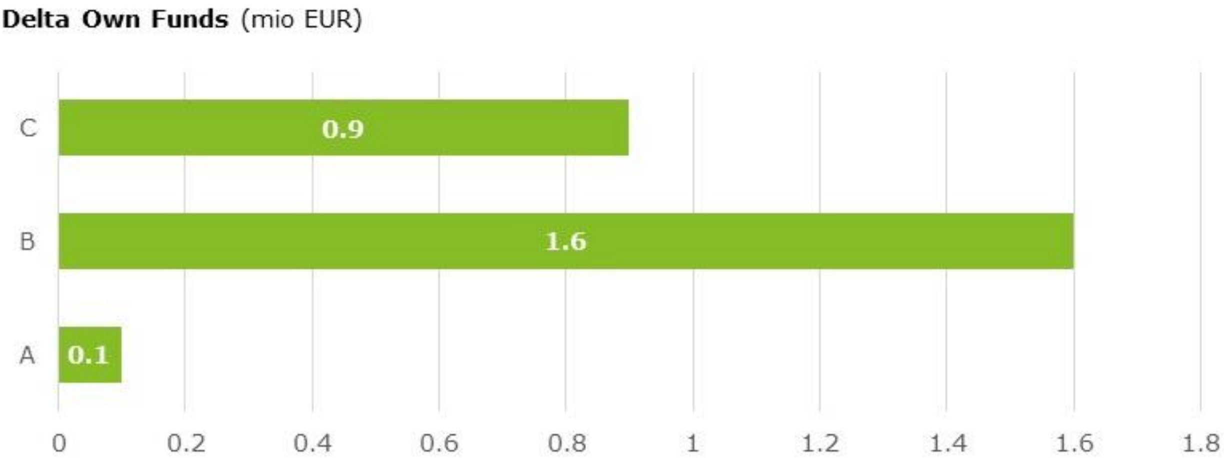

Figure 5: Change in Own Funds due to a drop in liquidity of BBB non-financial corporate bonds

Further developments and potential synergies

The purpose of this section is to briefly mention some areas where the proposed pragmatic approach could be extended when discounting insurance liabilities in a specific context with appropriate disclosures.

Solvency II

Liability bucketing

A more nuanced approach could be developed by considering the illiquidity features of the liabilities and any eventual illiquidity discrepancy between assets and liabilities.

A highly liquid insurance contract is characterized by the high unpredictability of its cash flows and the existence of a surrender value at any time without any redemption or tax penalty.

We define a simple application ratio per homogenous illiquidity liability bucket ($x\%_{bucket}$), such that we can generalize equation 17:

$$VA_{bucket} \approx x\%_{bucket} * \mathrm{LS}^{*} . \frac{\mathrm{dur_A}}{\mathrm{dur_L}} . \frac{\text{Total CF Bonds}}{\mathrm{w_B} * \text{Total CF } Liab}$$

This simple method reflects the fact that a less liquid insurance contract is less valuable (similarly to illiquid assets), such that a higher VA could be used to discount the CF.

Before Solvency II came into force, we note that both QIS5 and LTGA exercises proposed an application ratio depending on the type of insurance liabilities. At international level, the Insurance Capital Standard (ICS) which is expected to be applied by the end of 2019 to internationally active and globally systemic insurance groups proposes in its current field test three different discounting options, one of them being based on currency representative assets with two different ratios to be applied on risk corrected spread (100% in case of replicated annuities, 80% in other non-unit linked business).

Each insurer could define different liability buckets with the related application ratios. It might also be instructive for internal purposes to allocate the assets per liability bucket and investigate by how much the VA at bucket level would differ from the VA at entity level.

Dynamic VA

The dynamic VA refers to modelling a VA which changes in line with credit spreads over one year forecast. EIOPA acknowledges the current existence of diverging practices within local supervisors as both constant and dynamic VA are observed when calculating the spread risk under internal models. EIOPA issued in December 2017 an opinion calling for consistent practices among supervisors stating among others that "Undertakings shall demonstrate that by using the Dynamic VA its Solvency Capital Requirement is at least as high as if replicating the EIOPA VA methodology".

A possible extension of this paper would be to study the dynamic feature of the VA, the consistency between the insurer VA level and its SCR spread and whether in line with the above application ratio, there could be a deterioration of the illiquidity mismatch in adverse scenarios requiring eventually an additional capital charge for illiquidity.

From an ORSA perspective and looking beyond one-year forecast in line with the business plan, it might also be interesting to include the adjusted spread coming from the reinvested assets in the future.

Enhanced reporting

The proposed methodology is transparent and can be very useful both for supervisory and risk management purposes. To fully support supervisors' dialogue at country and European level, it would be appropriate to perform an analysis of change to step from the EIOPA VA to the newly-proposed "Own VA". Insurers should also analyze the impact of their own VA, and provide a reconciliation with the monetary VA. This, in turn, would be accompanied by various sensitivity/scenario analyses and provide useful extra information to supervisors as part of the pillar 2 process.

In case of liability bucketing or dynamic VA, insurers would include a statement on the method and assumptions used together with the impact of this approach compared to the standard VA.

IFRS17

IFRS17 is the International Financial Reporting Standard applicable on insurance contracts as from 2021. The very objective of Solvency II and IFRS17 differs: Solvency II aims at protecting policyholders against insurers' insolvency and increasing financial stability whereas IFRS17 aims at giving a faithful representation of the insurance service and finance performance to financial markets.

This insolvency risk versus value generation context has several implications including the definition of appropriate discount rates. Under Solvency II, the insurer should meet its obligations with certainty (i.e. risk free rate plus an eventual VA to avoid artificial volatility) whereas under IFRS17, insurance liabilities should be valued consistently with financial instruments providing similar characteristics.

There is no prescribed curve under IFRS17 but the following principles should be respected: "Discount rates must reflect the characteristics of the insurance contracts and should be consistent with observable market prices of financial instruments with cash-flows that are consistent with the insurance contract's characteristics in terms of timing, currency and liquidity".

Two different methods are allowed to determine rates for discounting cash flows that do not vary based on the returns of underlying items: either a bottom-up approach (liquid risk free curve adjusted for liquidity premium of the insurance contracts) or a top-down approach (current market of returns of reference portfolio adjusted for risk factors that are not present in the insurance portfolio).

Further investigation is still needed but it already appears that the methodology set out in this article allows working at a sufficient granular level to determine the Monetary VA per homogenous group of insurance contracts whereas its translation into a spread on top of the risk-free rate sets out a framework for generating exactly such a bottom-up discount rate. It should however be noted that IFRS17 does not require to effectively hold the reference asset portfolio but fewer adjustments would be required if those assets present similar characteristics of the insurance contracts. To foster a sound risk management under Solvency II and reduce IFRS17 Profit & Loss volatility under the OCI solution[32], it is however desirable to rely on actual insurers' investment.

As IFRS17 aims at comparability and requires discounting at a very granular level[33] to assess properly the contractual service margin at inception (unearned profit), we understand that the proposed methodology could be leveraged but the data source and aggregation level would differ.

Conclusion

We decided to go "back to basics" to analyze an alternative approach for determining the volatility adjustment for risk management purposes under the pillar 2 of the Solvency II framework.

On the one hand, EIOPA considers a bottom-up approach at EU level, looking for a liquidity adjustment in the form of a spread on the discount curve for liabilities. We, on the other hand work at insurer level and derive an expression for the VA by considering the monetary impact on the assets in the form of an amount to be added to the MV of assets (or subtracted from liabilities).

Subsequently, we translated this monetary amount into an additive spread on the discounting curve taking into account the insurer specific liabilities features. This allows us to compare the "Own VA" with EIOPA value. Despite the differences in approach, reasonable agreements were observed. The ability to analyze the impact in this form enhances comparison with the VA as calculated by EIOPA and supports the necessary adjustments from a risk management perspective. Those reconciliations can foster a constructive dialogue with supervisors and ensure that the short term market volatility from fixed instruments is properly managed internally contributing to the global financial stability.

We illustrated our approach on a simplified example and concluded that this new methodology has the very advantage of leveraging on the current EIOPA VA approach while promoting a better risk management based on up-to-date market data and undertaking specific assets and liabilities.

Finally, a number of suggested next steps were identified under Solvency II to take into account the illiquidity features of liabilities, the concept of dynamic VA and enhanced reporting. We also drew a parallel between our methodology used to determine the own VA formula with the bottom-up discounting approach under IFRS17. The proposed methodology would then have the merit of being flexible, transparent and applicable both in the prudential and financial framework.

[32] It is possible to reduce significantly IFRS17 P&L volatility due to interest rate movements if the 2 conditions below are met:

- investment assets under IFRS9 qualify for Fair Value through Other Comprehensive Income (FVOCI) where interest revenue is recognized in P&L whereas all other changes in Fair Value are recognized through OCI;
- application of the OCI solution under IFRS17 where the difference between the locked-in discount rate at contract inception and discount rate at reporting period is recognized in OCI.

[33] Contracts issued within one year are classified as at initial recognition "onerous","no significant possibility of becoming onerous", "remaining contracts".

Glossary of acronyms

Acronym	Definition
ALM	Asset Liability Management
BEL	Best Estimate of Liabilities
BP	Basis Point
CDS	Credit Default Swap
CF	Cash-Flow (undiscounted)
CHF	Currency Swiss Francs
CoD	Cost of Downgrade
Corr	Correlation
CR	Coverage Ratio by fixed income assets: ratio between Fixed Income Assets and Best Estimate of Liabilities
CRA	Credit Risk Adjustment
dur L	Duration of Liabilities
ECB	European Central Bank
EIOPA	European Insurance and Occupational Pensions Authority
EUR	Currency Euro
FINMA	Finanzmarktaufsicht: Swiss supervisor
FV	Fair Value
gov	Government bond
ICS	International Capital Standard developed by the International Association of Insurance Supervisors
IER	Internal Effective Rates
$IER_{yield\ corrected}$	- Generic bond-portfolio (government or corporate) risk-corrected market yield
$IER_{yield\ market}$	- Generic bond-portfolio (government or corporate) market yield
$IER_{yield\ RfR}$	- Corresponding bond-portfolio risk-free rate
IRS	Interest Rate Swaps
-IBOR	Inter-bank offered rate
LLP	Last Liquid Point
LS	Liquidity Spread
LTA	Long Term Average spread
LTG(A)	Long Term Guarantee (Assessment). The LTGA assessed in 2013 a set of potential measures for long-term guarantees products under volatile market situations. This resulted among others in the VA concept. This LTG package is expected to be reviewed by January 2021.
MV	Market Value
OCI	Other Comprehensive Income
OIS	Overnight Indexed Swap
ORSA	Own Risk and Solvency Assessment as requested under pillar 2 of Solvency II where risk, value and business planning are integrated based on the management perspective.
PD	Probability of Default
P&L	Profit and Loss account
RC	Risk Correction
RfR	Risk free Rate

Acronym	Definition
SII	Solvency II
SST	Swiss solvency test
UFR	Ultimate Forward Rate
VA	Volatility Adjustment

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Appendices

Appendix A: Dealing with the occurrence of negative liquidity spreads

How can one have negative liquidity spreads?

Even though the previously preposterous idea of negative interest rates has become a reality, we do not yet live in a world with negative liquidity spreads. ***The reason for the occurrence of negative liquidity spreads in EIOPA methodology, lies in their assumption of using a risk correction of 30%*LTAS and their choice of risk-free rate (EIOPA curve)***.

As previously discussed, the risk-correction aims at capturing the credit related component of a spread (in other words, EIOPA assumes *Credit Spread = 30%*LTA*). Deducting the credit spread from the bond spread, gives the non-credit related component of the bond spread (the liquidity spread). We have that:

$$\text{Bond Yield} = \text{Risk Free Rate} + \underbrace{\text{Credit Spread} + \text{Liquidity Spread}}_{\text{Bond Spread}}$$

Provided the risk-free rate represents a liquidly traded rate, one would assume a non-negative liquidity spread. EIOPA assumes that their risk-free rate is derived from liquid swaps, and hence that any liquidity component of a bond spread will be non-negative. Furthermore, if the risk-free rates were to be "credit-risk free", then one would also assume that the credit spread is greater than or equal to zero for each bond, and hence that the bond spread would be non-negative.

In practice, however, we observe negative bond spreads over EIOPA risk-free rate for a number of highly rated European government bonds. At first glance, a negative bond spread seems impossible. Indeed, a negative bond spread would imply a negative credit spread. In other words, the bond is less risky than the risk-free rate. ***The reason behind the existence of negative bond spreads is that EIOPA rate curve corresponds to a lending rate (a forwarding rate), whereas the government bond rates are deposit rates***.

Indeed, the EIOPA curve is based on interest rate swaps (IRS), which correspond to inter-bank lending rates (-IBOR rates) which are financial instruments traded in a Deep, Liquid and Transparent market ensuring market consistency. The favorable aspect of using inter-bank lending rates (-IBOR) over deposit rates (e.g. OIS) is the presence of a far more liquid -IBOR futures market (this is due to the fact that commercial loans typically reference -IBOR rates, and thus require a -IBOR hedge). The downside of using -IBOR rates in the context of building a risk-free curve, however, is that they still contain a credit risk component. EIOPA tackles this problem by adjusting the -IBOR swap rates with a parallel downward shift: the Credit Risk Adjustment (CRA). The calculation of the CRA is based on 50 percent of the average of the difference between the -IBOR rate and the Overnight Indexed Swap (OIS) rate, over a period of one year. The adjustment shall not be lower than 10 basis points and not higher than 35 basis points[34]:

$$CRA = \min\left(\max\left(50\% \frac{\sum_{i=1}^{N}(LIBOR_i - OIS_i)}{N}; 0.1\% \right); 0.35\% \right).$$

The Overnight Indexed Swap rate (OIS) corresponds to a daily capitalized deposit rate with a central bank (for EUR this is the ECB). Typically, the OIS rate is the least risky deposit rate for a given currency, and is lower than the -IBOR rate[35].

[34] Article 45 of the Delegated Acts of Solvency II.
[35] The average spread of 2017 was 12 BP – data from www.emmi-benchmarks.eu.

In the current interest rate climate, we observe that, despite the application of the CRA, the EIOPA rate still lies above the OIS curve, as illustrated Figure 6 below.

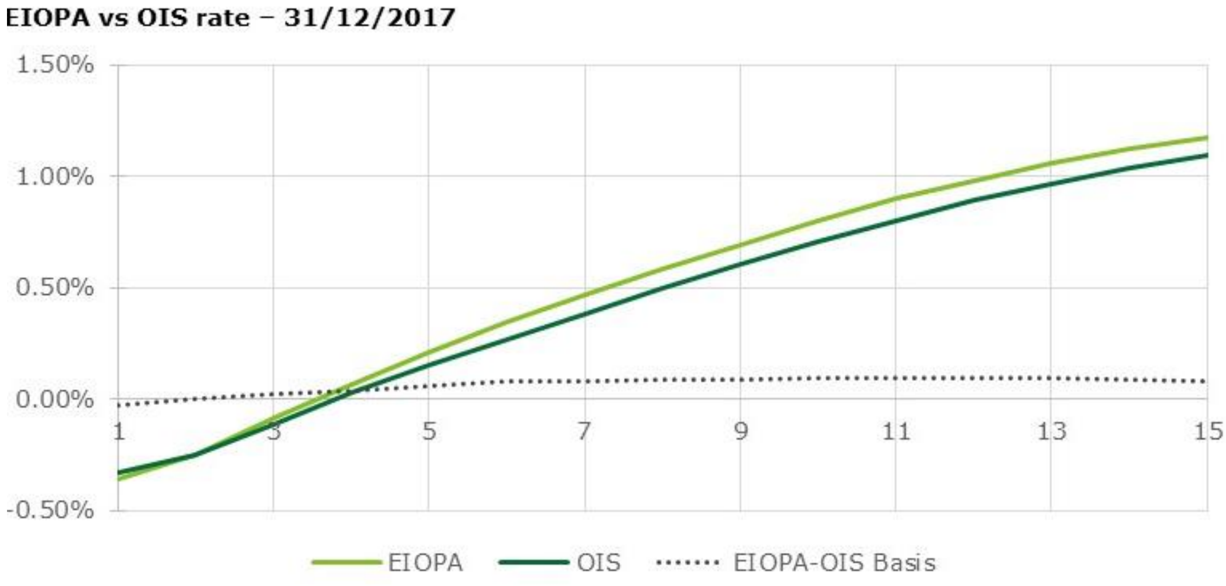

Figure 6: OIS curve versus EIOPA curve at valuation date 31/12/2017.

The proposed method would yield a positive liquidity spread while using the EIOPA rate as risk-free rate:

$$Liquidity\ Spread = Bond\ yield - rate_{OIS} - X\% \cdot LTAS_{OIS}.$$

Impact on the Country VA

As mentioned above, EIOPA Country VA calculation treats government bonds separately, and hence is affected by negative liquidity spreads. A consequence of this, is that the Country VA is extremely low, when compared to the EIOPA VA (at 31/12/2017 the EIOPA Currency VA was equal to 10 BP, whereas the Belgian Country VA was around 2 BP).

The Country VA is aimed at capturing situations where a country suffers a credit downgrade, which would lead to significant drop in government bonds from that country. The Country VA only applies when the risk corrected country spread is greater than twice the risk-corrected currency spread **and** the risk correct country spread is greater than 100 BP.

Due to the negative liquidity spreads, achieving this level of 100 BP, would mean an extremely severe downgrade. Using the data of 31/12/2017 for a generic Belgian government bond portfolio[36], the Belgian government bond spread would have to increase to at least 325 BP for the Country VA to be triggered. Such an increase would, for the generic Belgian portfolio, correspond to a drop in Market Value of total assets of approximately 8%.

To put into perspective the likelihood of such an increase in spread; we see that on 31/12/2017, the Portuguese 10Y government bond spread equals approximately 331 BP (compared to approximately 13 BP for Belgium). Furthermore, the historical maximum Belgian government bond spread over the last 10 years was approximately 330 BP[37].

[36] See full description in the Illustrative Example section.

[37] This refers to the spread of the 10Y Belgian government bond yield (OLO) on top of the EUR swap rate in December 2011. Data provided by NBB.

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