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Judging the appropriateness of the Standard Formula under Solvency II

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Introduction

Solvency II, which went live on January 1, 2016, provides an extensive set of unified rules for the solvency assessment, management and reporting of European insurers. This is framed in a three-pillar structure. The calculation of the Solvency Capital Requirement (SCR) is part of the first pillar. Insurers may use the Standard Formula (SF) to calculate the SCR.

The SF aims to capture the risk that an average European (re)insurance company is exposed to. However, the SF is not perfect and may not be appropriate for all (re)insurance companies. Nonetheless, the majority of European insurers currently uses the SF (see EIOPA data shown in Figure 1).

FIGURE 1: NUMBER OF ENTITIES USING DIFFERENT METHODS OF SCR CALCULATION

	STANDARD FORMULA	PARTIAL INTERNAL MODEL	FULL INTERNAL MODEL	TOTAL
LIFE	626	27	28	681
NON-LIFE	1,860	35	44	1,939
COMPOSITE	395	21	14	430
TOTAL	**2,881**	**83**	**86**	**3,050**

All (re)insurers using the SF have to assess the appropriateness of the SF on an annual basis as part of the Own Risk and Solvency Assessment ('ORSA') process, which is part of Pillar 2 of Solvency II.[2]

EIOPA has provided some high-level guidance in the Guidelines on ORSA (see [6]), and it also prepared a paper on the assumptions underlying the SF SCR calculation (see [2]). In the Guidelines on ORSA it says:

> *"The undertaking should assess whether its risk profile deviates from the assumptions underlying the SCR calculation and whether these deviations are significant. The undertaking may as a first step perform a qualitative analysis and if that indicates that the deviation is not significant, a quantitative assessment is not required."*

The Solvency II legislation offers no further guidance on how to assess the appropriateness of the SF.[3] Although some additional guidance may be received from the national supervisor, it is mainly up to each individual company to come up with a framework to judge the appropriateness of the SF.

This is a complicated and to some extent inherently subjective exercise. In this article we propose a specific framework that companies may choose to use for this purpose which is based on the approach outlined by the Dutch Royal Actuarial Society (see [3]).

First, we will provide a short overview of the structure of the SF. Second, we will present the suggested framework. Third, we present some worked examples of this framework. Finally, we discuss some of the challenges and pitfalls that need to be considered.

Assessment of appropriateness

The SF seeks to quantify all material risk exposures that a (re)insurer is exposed to. This includes the following main categories of risk:

- Market risk
- Underwriting (life, health and non-life)
- Counterparty default risk
- Intangible asset risk
- Operational risk

The market risk and underwriting risk modules are further subdivided into sub-risks. For each risk module (or sub-risk module), capital requirements are calculated. These capital requirements are aggregated into an overall capital requirement using correlation matrices.

To assess the appropriateness of the SF we propose undertaking a qualitative and a quantitative assessment. In order to draw an informed conclusion, companies should consider performing both assessments. In the next paragraphs we will describe the framework for this.

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[2] As required under Article 45.1(c) of the Solvency II Directive.

[3] The Delegated Acts specify some guidelines for the deviation from SCR assumptions to calculate add-ons in Articles 279 and 282.

QUALITATIVE ASSESSMENT

First, a qualitative assessment should be performed to assess whether the methodology that is used in the SF is appropriate for the company. As part of the qualitative assessment, companies should consider assumptions, methodology and parameters.

Assumptions

The underlying assumptions used to derive the SF may not be appropriate for the risk profile of the company. Therefore, the assumptions stated in the EIOPA assumptions document [2] should be checked. The assumptions used for the individual risk modules, the aggregation methodology and the overall structure of the SF are listed in this document.

Example: One of the assumptions used for interest rate risk is that the company is not exposed to material inflation or deflation risk. The company should consider carefully whether these assumptions for its portfolio risks.

Additionally, some assumptions underlying the Standard Formula are assumptions about the market itself and not about the risk profile of an average European company. These assumptions should be addressed as well.

Example: The spread module states that no capital is required for investments in European government bonds.[4] The implicit assumption is that these investments are risk free. Based on the experience during the years since 2009, most observers would conclude that this assumption is unrealistic.

Finally, the insurance company should complete the qualitative assessment with its own view on the appropriateness of the SF. Expert meetings could be organised to facilitate this.

Example: The stress scenario for the risk of a decrease of the interest rate term structure does not allow for negative interest rates. Given the current market situation, this is unrealistic.

Methodology

Next, the company should judge the appropriateness of the methodology that is employed in the SF. This includes assumptions that are implicit in the SF but are not specified in the assumptions document. The scenario that is used to calculate the SCR should represent the 99.5% Value-at-Risk (VaR) on a one-year horizon. However, this is dependent on the risk profile of the company. The company should check to see if this methodology is consistent with its own risk profile.

Example: The scenario that is used for the longevity risk module uses a permanent decrease of 20% in the mortality rate, the underlying assumption being that an age-insensitive shock is representative for the 99.5% VaR. This may not be appropriate for every company. If the longevity risk profile of the company differs by age group, then a parallel shock could result in gains for some groups and losses for different groups. In this case, an age-dependent shock could be more appropriate to calculate the SCR.

Parameters

In conjunction with the assessment of the methodology that the SF uses, (re)insurers should verify the appropriateness of the parameters that are used in the methodology. If the methodology is appropriate, use of inappropriate parameters could still result in a capital requirement that does not correspond to the company's portfolio.

Example: The SF uses a 25% decline in prices to calculate property risk. The calibration is based on total return indices for the UK property market, taking into account the retail, office, industrial and residential sector. It may not be appropriate for the company if its property portfolio is substantially different from the reference portfolio.

QUANTITATIVE ASSESSMENT

In the previous section we looked at the general methodology that is employed in the SF. Even for the most average European insurer, the SF will never exactly match the risk profile of the company. Thus, separately from the qualitative assessment, we need to quantify the materiality of this difference.

First we describe the ideal approach and the practical challenges there are to using it. Then we describe an approach that incorporates these challenges.

Ideal approach

For this exercise, ideally we would calculate the required capital in two ways: once with the SF (the 'SF SCR') as it is and once with the SF if it were modified to reflect the actual risk profile of the company (the 'ideal SCR'). If the ideal SCR differs from the SF SCR by more than 10%,[5] then we consider the difference to be material and have to conclude that the SF is

[4] Delegated Acts, Article 180.2.

[5] Delegated Acts, Article 279 states that the difference is material if the ideal SCR exceeds the SF SCR by more than 10%, unless there is strong evidence that this is not the case or if the ideal SCR exceeds the SF SCR by more than 15%. For the purposes of this article we will use the more stringent 10% boundary.

not appropriate. This is the approach described in the Delegated Acts in relation to setting capital add-ons.

There are two practical issues with this approach. First, the ideal SCR is usually not known. It is a fair assumption that a company that employs the SF does not have a complete internal model that perfectly matches its risk profile. Second, this approach is for the total SCR. In practice, we want to judge the appropriateness of each component of the SF separately.

Suggested approach

While the ideal SCR will usually not be available, we can construct a materiality interval around the SF SCR. We consider the difference between the ideal SCR and the SF SCR to be material if it is more than 10%. We can thus calculate the boundaries of the interval that the ideal SCR has to cross for the difference to be material.

Similarly, we can translate this into a criterion for each of the individual SF risk modules. We consider a difference to be material for a risk sub-module if the resulting change at the sub-module level (meaning market risk, life risk, non-life risk, etc.) is larger than 10% of the total SCR. Working backwards, we can perform a reverse stress test to judge the appropriateness of the SF at the individual risk module level.

The following steps are involved in this process:

1. Calculate the SCR using the SF
2. Use 10% of the SF SCR calculated in Step 1 as the materiality boundary
3. For each risk (sub)module, calculate how much the capital requirement needs to move by in order to breach the materiality boundary defined in Step 2 on the risk module level
4. Determine the changes to the SF calibration that would be necessary to justify the capital as calculated in Step 3
5. Determine the likelihood of these changes

This approach is in line with the one described by the Dutch Royal Actuarial Society (see [3]). It should be stressed, however, that there is no legal requirement to carry out this assessment using the suggested approach above. The EIOPA guidance states that a quantitative assessment is only required if the qualitative assessment shows that the deviation is material. However, in practice, it is difficult to judge materiality based on a qualitative assessment alone.

Drawing conclusions

The qualitative and quantitative analysis outlined above can be used to draw a general conclusion about the appropriateness of the SF for each risk category. Although some part of this assessment will always be subjective, we suggest using a framework to minimise the subjectivity. One way would be to use the matrix shown in Figure 2.

Despite the EIOPA guidance, it is difficult to reach an informed conclusion without performing both the qualitative and quantitative assessments. The decision matrix relies on the conclusions drawn in the qualitative and quantitative assessments. Here we have assumed that the company can draw conclusions on whether an assessment is unsatisfactory (✗), indeterminate (=), satisfactory (✔) or very satisfactory (✔ ✔). How the company defines these conclusions is up to the company itself.

In the decision matrix, the main emphasis is on the conclusion of the quantitative assessment. The reason for this is that even when the qualitative assessment shows that the methodology is not appropriate for the risk profile of the company, the SF may still result in the appropriate amount of capital. Two vastly different methodologies could still lead to the same answer. This would, however, require additional research, possibly taking into account proportionality.

FIGURE 2: DECISION MATRIX

QUALITATIVE	QUANTITATIVE	CONCLUSION
✔	✔ ✔	HIGH LEVEL OF CONFIDENCE OF APPROPRIATENESS
✔	✔	LIMITED LEVEL OF CONFIDENCE OF APPROPRIATENESS
= / ✗	✔ ✔	LIMITED LEVEL OF CONFIDENCE OF APPROPRIATENESS
✔	=	NO REASON TO ASSUME CAPITAL IS NOT APPROPRIATE
✔	✗	REASON TO BELIEVE CAPITAL MAY NOT BE APPROPRIATE
= / ✗	✗	NOT APPROPRIATE

Worked out examples

Our proposed methodology is best illustrated by showing worked out examples. In this section we provide the assessment for two risk types for a fictitious company.

For our fictitious company we assume the following SCR build up (in millions of euros).

FIGURE 3: SCR BUILD-UP OF FICTITIOUS COMPANY

CATEGORY	SCR
MARKET	107.5
LIFE	150.0
NON-LIFE	60.0
DIVERSIFICATION	– 96.3
BASIC SCR	**221.2**
OPERATIONAL	50.0
SCR	**271.2**

Here we assume that there is no exposure to property, concentration, counterparty default, intangible or health risk. There is also no adjustment for the loss absorbency of deferred taxes.

CURRENCY RISK

In this example, we will assess the appropriateness of the capital requirement for currency risk. Our fictitious company has currency exposure arising from policies issued in the United States. The company has USD liabilities equal to €100 million on the Solvency II balance sheet, which is unhedged: No assets denominated in any currency other than euros are on its balance sheet. The liabilities do not include any discretionary obligations. The net exposure to the USD is thus €100 million.

Qualitative analysis

For the qualitative assessment, we look at the assumptions, methodology and parameters of the SF as outlined on page 2.

Assumptions

The EIOPA assumptions document lists the following underlying assumptions for currency risk:

1. All currency exposure is contained in this sub-module. Currency effects have been stripped out of the other market risk sub-modules.
2. For currencies pegged to the euro, a reduced shock factor is used.

Additionally the Delegated Acts list the following assumptions:

3. Investments in listed equities are assumed to be sensitive to the currency of its main listing.
4. Non-listed equities are assumed to be sensitive to the currency of the country in which the issuer has its main operations.
5. Immovable property is assumed to be sensitive to the currency of the country in which it is located.

Finally, the SF contains the following implicit assumption:

6. The stress scenarios for the different currencies are 100% correlated.

Assumption 1 is about the set-up of the SF by EIOPA. Assuming our fictitious company does not include currency effects in the calculations for the other market risk sub-modules, this assumption seems appropriate.

Assumption 2 is not relevant for our company as the only exposure is to the US dollar. Regardless of this, the assumption seems appropriate for a pegged currency to the euro as our company's balance sheet is denominated in euros.

Assumptions 3 to 6 are not relevant to our company because no assets denominated in currencies other than the euro are on the company's balance sheet.

Methodology

The SF methodology contains the following elements:[6]

1. The capital requirement for currency risk is calculated as the sum of the capital requirements for currency risk for each foreign currency.
2. For each foreign currency, the capital requirement is equal to the larger of:

   - The capital requirement for an increase in the foreign currency to the local currency.

   - The capital requirement for a decrease in the foreign currency to the local currency.
3. The capital requirement is calculated as the loss in basic own funds due to an instantaneous increase or decrease of 25% in value of the foreign currency.
4. For currencies pegged to the euro, a reduced shock factor is used.
5. The impact for participations in financial and credit institutions is considered for only part of the value.
6. The impact of the scenario in Element 2 should take into account the impact of the scenario on future discretionary benefits included in the technical provisions.

For our fictitious company, the entire exposure is to US dollars, which is not due to strategic participations and does not include any discretionary elements. As the exposure is a liability for the company, the adverse scenario for the company would be an appreciation of the US dollar with respect to the euro.

[6] Delegated Acts, Article 188.

Therefore, the capital requirement is determined by the loss in basic own funds due to an instantaneous increase in the value of the US dollar to the euro. As this corresponds to the risk profile of the company, the methodology looks appropriate.

Parameters

The scenario to calculate the capital requirement uses an instantaneous shock of 25%. This value has been calibrated by EIOPA based on a basket of currencies (see [2] and [4]). The portfolio of our fictitious company, however, differs substantially from this basket of currencies. To check if the stress parameter is appropriate for the portfolio of our fictitious company, we should compare this value to the distribution of the exchange rate of the US dollar against the euro.

For this exercise we use Bloomberg data for the USDEUR exchange rate for the period January 1997 to December 2016. We calculate the yearly change over the previous year for each month (overlapping data points). This data suggests that over this period, the 99.5% yearly VaR is a 22% increase in the value of the US dollar. The 99.5% yearly VaR for a decline in the US dollar is 26%. Based on these observations, the use of a 25% scenario to approximate the 99.5% yearly VaR seems reasonable.

Conclusion

For the qualitative assessment we conclude that, based on the analysis above, that despite the differing portfolio composition the SF is appropriate for the currency risk of our company.

Quantitative analysis

For the quantitative analysis we follow the steps outlined on page 3.

Step 1

We assume the following SCR Market build-up (in millions of euros).

FIGURE 4: SCR MARKET BUILD-UP OF FICTITIOUS COMPANY

CATEGORY	SCR
INTEREST	40.0
EQUITY	10.0
SPREAD	80.0
CURRENCY	25.0
DIVERSIFICATION	– 47.5
SCR MARKET	**107.5**

In this example, the currency SCR is due to a €100 million exposure to the US dollar. The capital charge under the SF is 25%, resulting in a €25.0 million SCR.

Step 2

The materiality boundary is 10% of the total SCR: €27.1 million.

Step 3

For a difference to be material, the SCR for the relevant sub-module has to change by the materiality boundary calculated under Step 2. As we are looking at currency risk, this means a change is material if it causes the SCR for market risk to change from its current value of €107.5 million (see Figure 4) to a value outside of the materiality interval of €80.4 to €134.6 million.

If we keep everything else constant and solve backwards, this translates to a materiality interval for the currency risk SCR of €0 to €66.9 million.

Step 4

As the total exposure is €100 million, the materiality interval for currency corresponds to capital charges of 0% and 66.9%.

Step 5

The lower boundary of the materiality interval is clearly satisfied, as it is not possible for the currency SCR to be negative. A currency SCR of €0 leads to a market SCR of €96.4 million. Therefore, it is not possible for the market SCR to fall below the lower materiality boundary of €80.4 million.

To reach the upper boundary of the materiality interval, the US dollar/euro exchange rate would have to increase by 66.9% over a period of one year. Between 1997 and 2016 the maximum increase in US dollar/euro exchange rate over any 12-month period (based on overlapping month end data) was 22.1%, while the maximum decline of the US dollar to the euro was 26.1%. This suggests that an increase of 66.9% is far more extreme than a 99.5% one-year VaR number.

Conclusion

For the qualitative assessment, we conclude that based on the analysis above, the SF is appropriate for the currency risk of our company.

Conclusion

FIGURE 5: DECISION MATRIX

QUALITATIVE	QUANTITATIVE	CONCLUSION
✔	✔ ✔	HIGH LEVEL OF CONFIDENCE OF APPROPRIATENESS

To draw our conclusion, we use the decision matrix framework listed in Figure 2 on page 3. The qualitative assessment is satisfactory. In the quantitative assessment we concluded that it would be highly improbably for the exchange rate to move in such a way as to breach the materiality interval.

Therefore, we conclude with a high level of confidence that the SF is appropriate for currency risk for our fictitious company.

LAPSE RISK

In this example we will assess the appropriateness of the capital requirement for lapse risk. Our fictitious company has €250 million in liabilities that are exposed to mass lapse. We assume that mass lapse is the dominant lapse scenario.

Qualitative analysis

As outlined on page 2, for the qualitative assessment we look at the assumptions, methodology and parameters of the SF.

Assumptions

The EIOPA assumptions document lists the following underlying assumptions for lapse risk:

1. Lapse up and lapse down scenarios are symmetrical stress scenarios.
2. The risk relating to the options that a ceding company of a reinsurance contract can exercise is not material.
3. A split between insurance policies falling or not falling within the scope of management of group pension funds in the mass lapse event shock is assumed appropriate.
4. Additional assumptions apply to the simplified calculation.

In our example we are considering mass lapse and not ceding options, group pension funds or the simplified calculation. Therefore, none of these assumptions apply to our example.

Additionally, the Delegated Acts list the following assumptions:

5. The policyholder is a natural person.
6. The events shall apply uniformly to all insurance and reinsurance contracts concerned.

Assumptions 5 and 6 are not specifically relevant in our example, but we assume that these assumptions are satisfied.

Methodology

The SF methodology contains the following elements[7]:

1. The capital requirement for lapse risk is calculated as the maximum of the capital requirements for upward lapse risk, downward lapse risk and mass lapse risk.
2. The stress is only applied to contracts where the application leads to an increase in technical provisions.
3. The risk margin should not be taken into account when calculating the capital requirement for lapse risk.
4. All policyholder options should be taken into account.
5. The type of discontinuance that most negatively affects the company's own funds should be used as the basis for the mass lapse risk scenario.

Element 1 deals with the fact that a lapse event can take various forms. It seems appropriate to use the scenario that has the largest impact on the own funds of the company.

Element 2 could lead to an overestimation of the SCR because portfolio diversification is not entirely accounted for.

Element 3 is at odds with the reality if the scenario actually occurs where the risk margin will indeed be affected by lapses. This assumption does not seem appropriate.

Element 4 seems appropriate because the lapse event can affect all policyholder options.

Element 5 is similar to Element 1, and we consider it appropriate for the same reason.

Parameters

For mass lapse, a 40% stress scenario applies. The original calibration (see [5]) was based on "an expert estimate based on past mass lapse events in the German life insurance market."

Mass lapse only occurs in an extreme scenario. Therefore, very little data is available to challenge the parameter. We have therefore not performed an alternative calibration for our fictitious company. However, it is possible that a bank-run-like scenario could occur once in every 200 years. Such a scenario could very well lead to a lapse rate of more than 40%.

Conclusion

The above gives rise to doubts about the validity of the SF methodology for our fictitious insurer, as the parameter shock could be too low.

Quantitative analysis

For the quantitative analysis we follow the steps outlined on page 3.

Step 1

We assume the following life underwriting SCR build-up (in millions of euros).

FIGURE 6: SCR LIFE BUILD-UP OF FICTITIOUS COMPANY

CATEGORY	SCR
MORTALITY	40.0
LONGEVITY	40.0
DISABILITY	15.0
EXPENSE	25.0
LAPSE	100.0
CATASTROPHE	5.0
DIVERSIFICATION	– 74.9
SCR LIFE	**150.1**

In this example the lapse SCR is due to €250 million worth of liabilities that are exposed to lapse risk. The capital charge

[7] Delegated Acts, Article 142.

under the SF is 40% for mass lapse, resulting in a €100 million SCR for lapse risk.

Step 2

The materiality boundary is 10% of the total SCR: €27.1 million.

Step 3

For a difference to be material, the SCR for life underwriting risk has to change by the materiality boundary calculated under Step 2. This means a change is material if it causes the SCR for life underwriting risk to change from its current value of €150.1 million (see Figure 6) to a value outside of the materiality interval of €123.0 to €177.2 million (after rounding).

If we keep everything else constant and back solve for the lapse risk SCR that causes the life underwriting risk SCR to change by this amount, we get a materiality interval of €70.8 to €128.5 million for the mass lapse risk SCR.

Step 4

As the total exposure is €250 million, the materiality interval for mass lapse corresponds to capital charges of 28.3% and 51.4% for this fictitious company.

Step 5

The confidence interval surrounding the stress scenario for mass lapse risk is relatively tight for the fictitious company. Therefore, we cannot conclude that the SF SCR lapse risk is appropriate for our fictitious company.

Conclusion

FIGURE 7: DECISION MATRIX

QUALITATIVE	QUANTITATIVE	CONCLUSION
= / ×	=	NO FINAL CONCLUSION CAN BE DRAWN. ADDITIONAL RESEARCH NEEDS TO BE PERFORMED.

To draw our conclusion we use the decision matrix framework listed in Figure 2 on page 3. In the quantitative assessment we concluded that the confidence interval surrounding the parameter was relatively tight. It is difficult to conclude that a mass lapse event outside the boundaries would be improbable in 200 years. Based on this analysis, it is not possible to conclude that the SF is appropriate for mass lapse risk for our fictitious company.

Challenges and pitfalls

This research provides a step-by-step approach to judging the appropriateness of the SF. Two practical applications were provided. For currency risk, it was concluded that the SF is appropriate with a high level of confidence for our fictitious company. For mass lapse risk, it could not be concluded that the SF is appropriate for our fictitious company.

The approach can be extended to other risks as well. This, however, may be challenging:

- We have considered simplistic examples above, but the approach may be more complicated for shocks with a number of different calibrations, e.g., spread risk or counterparty default risk.
- The approach outlined above does not consider risks that are not captured in the SF calculation, such as liquidity risk, inflation risk, reputational risk, etc. These risks also need to be considered in this assessment.
- (Re)insurers need to consider what steps to take if they conclude that the SF is not appropriate for one or more risk modules. EIOPA states the following options: align risk profile with the standard formula; apply for undertaking-specific parameters, where this is allowed; develop a (partial) internal model; or alternatively, the undertaking could decide to de-risk.
- Demonstrating the appropriateness of the operational risk SF SCR requires a detailed analysis.
- For life underwriting risks with a non-linear capital requirement, it may be necessary to re-run cash-flow models several times to obtain the right input for the reverse stress test.
- We note that correlations are sometimes overlooked when judging the appropriateness of the SF. It is, however, clear that the impact of both the aggregation methodology and the correlation parameters can be substantial.
- Finally, a conclusion should be drawn for the SCR as a whole. This should take into account the conclusions drawn for individual risks as well as possible interactions of these conclusions.

How Milliman can help

Milliman helped numerous insurers across Europe solve challenges related to the appropriateness of the SF. We have for example:

- Helped insurers judge the appropriateness of the SF for all risks.
- Judged the appropriateness of the SF for the risks not captured by the partial internal model of insurers.
- Helped insurers calibrate and apply for Undertaking Specific Parameters (USP).
- Performed Pillar 2 services such as ORSA implementations.
- Performed validations of (partial) internal models.
- Reviewed SF calculations.

References

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[6] 'Guidelines on own risk and solvency assessment', EIOPA, 14 September 2015.

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