Solvency II Risk Margin Update

Presentation to AAE Risk Management Webinar

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Agenda

- Background
  - EIOPA Holistic Impact Assessment attenuation proposal
- Standard Formula SCR implied attenuation rates
- Other comments

Presentation based on Kemp (2020). The Potential Impact of Multi-Year Dependencies on the Design of the Solvency II Risk Margin. *Nematrian*. See: www.nematrian.com/docs/MultiYearDependenciesRiskMargin20201130.pdf

Views and opinions expressed are those of the presenter and do not necessarily represent any official position or opinion of any organization with which he is associated.

About the speaker

Malcolm Kemp

- Malcolm Kemp is Chairperson of the AAE's Risk Management Committee
- He is an internationally known expert in risk and quantitative finance, with over 35 years' experience in the financial services industry including senior roles in insurance and investment management
- Malcolm is a Managing Director of Nematrian, an Associate at Barnett Waddingham, a visiting lecturer at Imperial College Business School and a member of the Advisory Scientific Committee of the European Systemic Risk Board

Background

Background: The Solvency II Risk Margin

- Solvency II risk margin (RM) based on an **exit valuation** that in theory targets a specific well-defined and implementable approach to 'production' of insurance liabilities (involving a 'run-off')
- Current calculation per SII Delegated Regulation Articles 37 – 39:

$$RM = CoC \times \sum_{t=0}^{T-1} \frac{SCR(t)}{\left(1 + r(t+1)\right)^{t+1}}$$

- Here, $SCR(t)$ is the projected SCR deemed to apply to a reference undertaking ('RU') assumed to take over the liabilities, $r(t)$ is annualised risk-free rate and CoC is the mandated cost of capital rate, currently **time-independent** and set at **6% pa**.

Background: The EIOPA HIA

- Design of RM specifically in scope of **Solvency II 2020 Review**
  - And in **UK HMT review** of how to regulate UK insurers after end of Brexit transition period
- Size and interest-rate sensitivity have both been questioned by the industry and some regulators, particularly in the context of **long-dated life insurance**
- Original EIOPA Solvency II 2020 Review proposals involved no change. More recent 2020 EIOPA Holistic Impact Assessment (HIA) included proposal to incorporate an **attenuation factor**, i.e.:

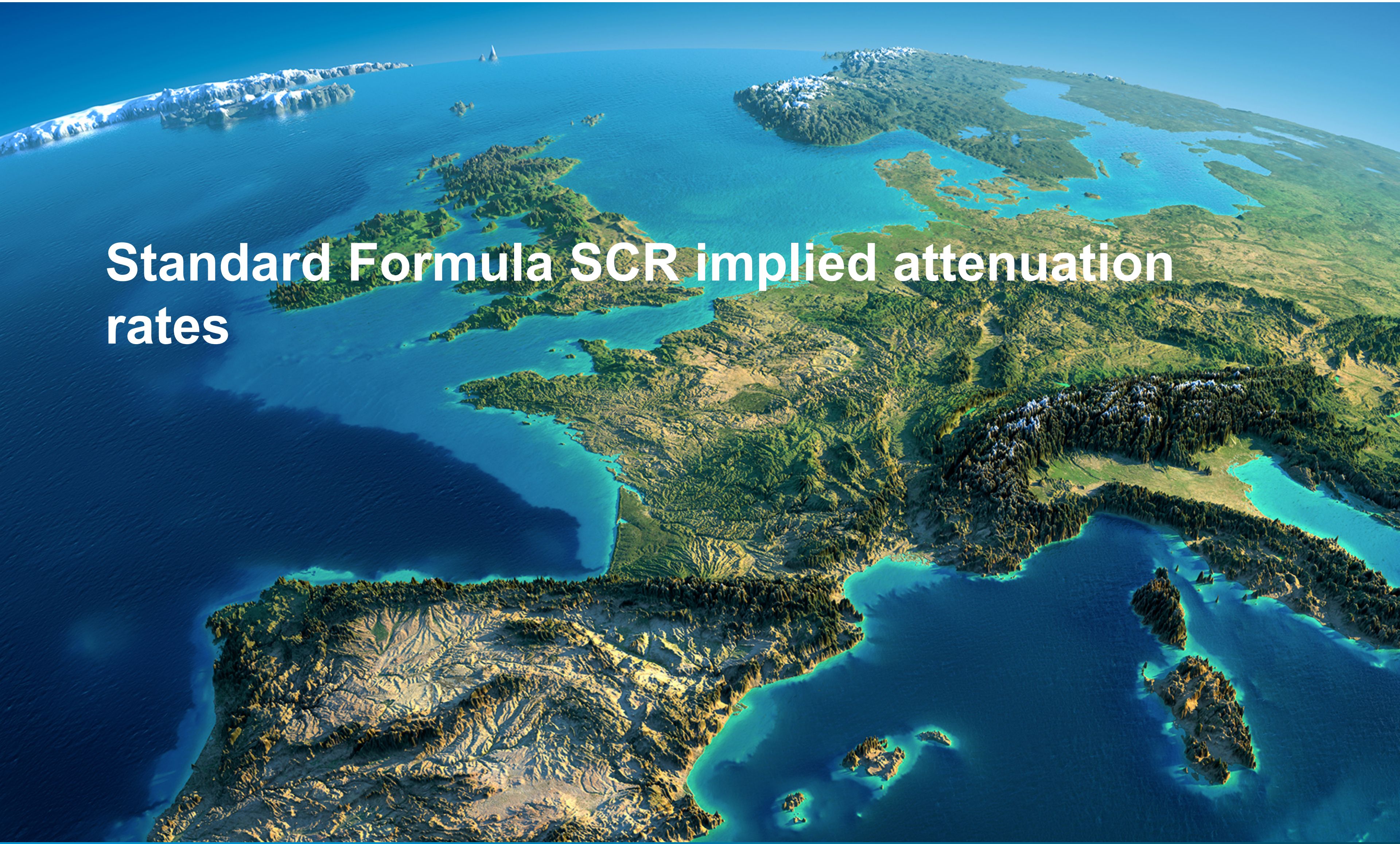
$$RM = CoC \times \sum_{t=0}^{T-1} \frac{SCR(t) \times \lambda(t)}{\left(1 + r(t+1)\right)^{t+1}}$$

- HIA proposal involved $\lambda(t) = \max(\lambda^t, 0.5)$ where $\lambda = 0.975$

Background: Previous AAE Work

- AAE (2019). *A Review of the Design of the Solvency II Risk Margin* explored theoretical underpins. If multi-year risk dependencies exist and are material, an attenuation factor $\lambda(t)$ may be justified
  - Risks exhibiting **negative autocorrelation** (e.g. mass lapse risk) might justify a **falling** $\lambda(t)$ as t increases. If $\lambda(t)$ does not decline can sometimes lead to obviously market inconsistent results
  - Risks exhibiting **positive autocorrelation** (e.g. some non-life liability risks like asbestos) might justify a **rising** $\lambda(t)$ as t increases
- Aim of this presentation/Kemp (2020) is to explore plausible $\lambda(t)$
- Some modest attenuation might also be justified by e.g. how investors view the shareholder limited liability 'put' (not explored further in this presentation)

Standard Formula SCR implied attenuation rates



Market implied attenuation rates (1)

- **Key insight**: valuation paradigm underlying Solvency II technical provisions targets market consistency
- The risk margin (RM) is a part of the SII technical provisions
- If we can identify a market consistent, i.e. 'risk-neutral', RM then the actual SII RM should ideally equate to it
- In a market consistent world, if a given risk is assumed to be correctly quantified by a loss of $X(t)$ at time $t+1$ and a risk neutral probability of occurrence of q in the year from t to $t+1$ then the cumulative risk-neutral cost will be (ignoring potential correlations between q and $r(t)$)

$$\sum_{t=0}^{T-1} \frac{q \cdot X(t)}{\left(1+r(t+1)\right)^{t+1}}$$

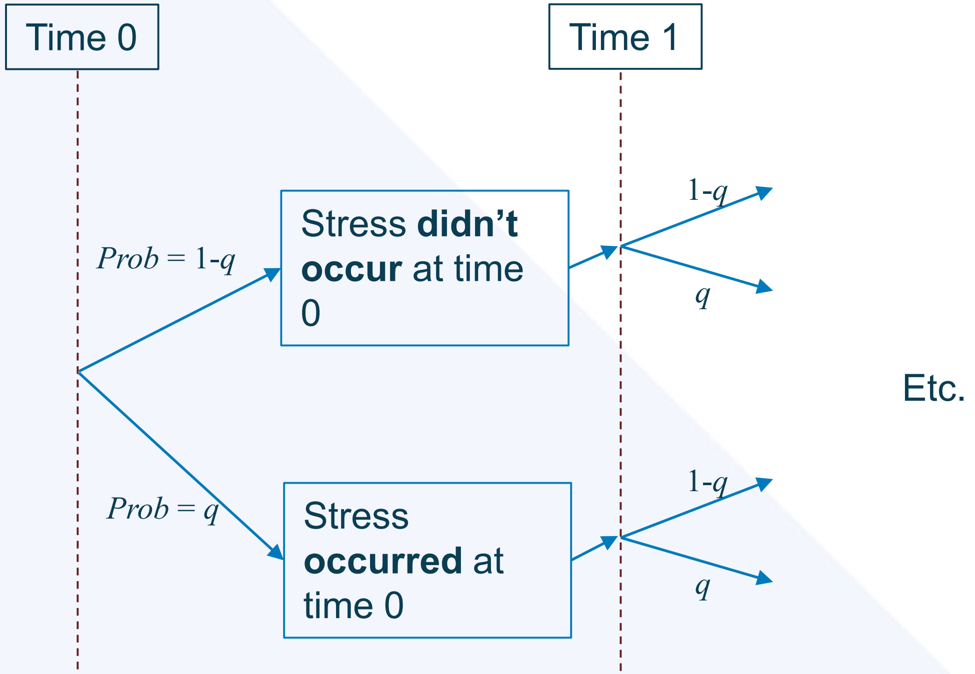
Market implied attenuation rates (2)

- Compare with actual SII RM formula
  - It seeks to quantify cost to be charged by hypothetical RU for taking over liability for unexpected (risky) outcomes
- For formulae to align in year 1 if the deemed 'unexpected loss' in that year is $SCR(0)$ we need q to satisfy:

$$q = CoC$$

- We can therefore quantify the (market consistent) cost of offloading unexpected losses via a **binomial tree** approach in which we branch each year depending on whether we suffer an unexpected loss
  - The **probability of branching** each year is $\boldsymbol{q = CoC}$
  - But **how do we determine the risk-neutral unexpected loss applicable to each node in the binomial tree**?

Binomial tree for calculating market consistent RM



- Here $q = CoC$
- But what (risk-neutral) unexpected loss should we assume arises during t to $t+1$ conditional on the number and sizes of unexpected losses that have occurred previously in the path in question?

Stylised potential path-dependencies

- Assume insurer has assets $A(k,t)$ and liabilities $L(k,t)$ where k indexes the relevant path dependent evolutions of the assets in a risk-neutral world including the unexpected losses
- Ignoring unexpected losses, assume $A(t) = \frac{T-t}{T} A_0$, $L(t) = \frac{T-t}{T} L_0$
  - I.e. assets and liabilities run off through time
- Assume **an unexpected loss occurring can be equated with a stress in line with the SII Standard Formula SCR occurring**
- Assume this involves a stress factor of S_A (or S_L) applied to a fraction F_A (or F_L) to the then assets (or liabilities) $A(k,t)$ (or $L(k,t)$).
- Usually we will have $S_A = S_L$ or stress will only apply to one side of balance sheet

If a stress occurs in year 1?

- Relatively simple
- E.g. a market stress (not deemed hedgable by the RU)
  - $A(0)$ falls by $A(0)F_A S_A$
  - $L(0)$ falls by $L(0)F_L S_L$
  - Overall stress is movement in own funds, i.e. the movement in assets minus liabilities, so is:

$$A(0)F_A S_A - L(0)F_L S_L = L(0)(KF_A S_A - F_L S_L) \quad where\ K = \frac{A_0}{L_0}$$

- I.e. 'unexpected' loss to include **in year 1** in the market consistent RM, $U(0)$, is just $SCR(0)$
  - Contributing $q \cdot U(0) = q \cdot SCR(0)$ before discounting, as per current RM formula

But what about year 2 onwards?

- Still relatively straightforward for branch paths along which no such stress has previously occurred
  - Logic in previous slide flows through essentially unchanged
  - Unexpected loss to include in this branch is $U(t) = L(t)(KF_A S_A - F_L S_L)$
  - $U(t)$ is also the $SCR(t)$ included in the current RM calculation
  - I.e. for such branches, the current RM calculation remains valid
- But more complicated for branches where one or more such stresses have previously arisen

Branches where stress has already arisen

- Most potential situations can be approximated by one of three cases, e.g. in year 2 if stress also happened in year 1:
  - **Case (1)**. Same absolute fall occurs (attenuated only by expected run-off of assets and liabilities through time), i.e. stress to include in market consistent RM is:

$$U(1) = A(1)F_A S_A - L(1)F_L S_L = SCR(1)$$

  - **Case (2)**. Same proportionate fall occurs, now applied to assets and liabilities post the earlier stress (and after allowing for expected run-off), i.e. stress to include is

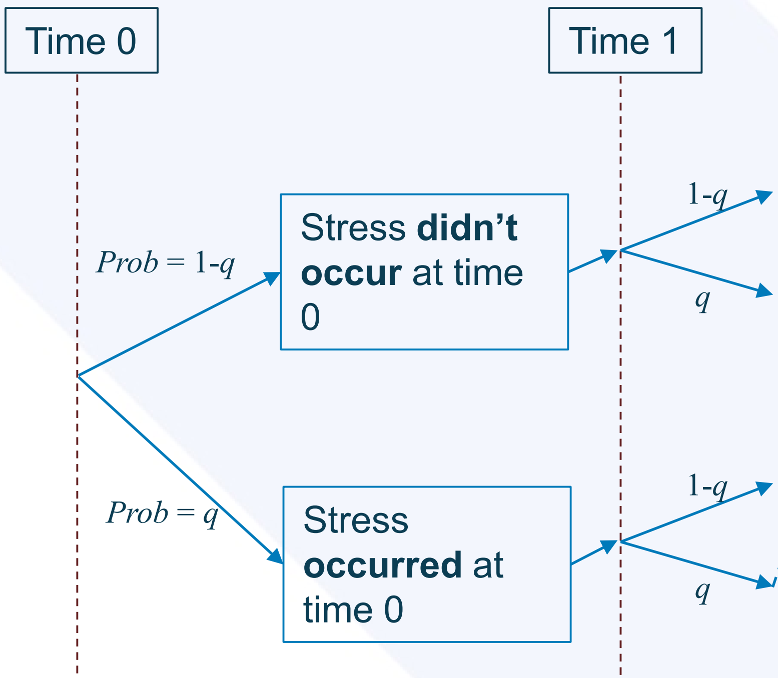
$$U(1) = A(1)F_A S_A(1 - S_A) - L(1)F_L S_L(1 - S_L)$$

  - **Case (3)**. No further stress is assumed to occur, i.e. stress to include is

$$U(1) = 0$$

- **For market risk**, Case (2) seems typically most plausible. Index is 6000 say and unexpectedly falls say 30% by 1800 to 4200. Next time happens seems more plausible to assume a further 30% fall, by 1260 to 2940, than another 1800 to 2400 or no fall at all.

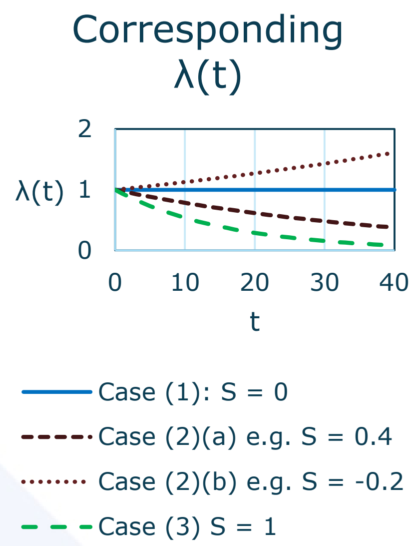
Binomial tree for calculating market consistent RM



Case (1): Stress "fully" repeats (as if hadn't happened at time 0), $S = 0$

Case (2): Stress only applied to post t = 0 stress assets and liabilities
(a) $0 < S < 1$
(b) $S < 0$

Case (3): Stress in effect doesn't repeat, $S = 1$



Further insight

In many cases the market consistent RM can be expressed analytically, with an attenuation factor that takes the form: $\lambda(t) = (1 - CoC \cdot S)^t$

Analytical formulae

- I.e. like the formula proposed in the HIA but with different $\lambda(t)$
  - **Case (1)**. Same absolute stress occurs (attenuated only by expected run-off of assets and liabilities through time)

$$q\sum_{t=0}^{T-1}\frac{SCR(t)}{\left(1+r(t+1)\right)^{t+1}} = CoC\sum_{t=0}^{T-1}\frac{SCR(t)\times\lambda(t)}{\left(1+r(t+1)\right)^{t+1}} \quad with\ \lambda(t) = 1^t = 1$$

  - **Case (2)**. Same proportionate stress occurs, n = number of times occurred previously, $S_A = S_L = S$ (or only one side of balance sheet affected)

$$\sum_{t=0}^{T-1} q \sum_{n=0}^{t}\frac{\binom{t}{n} q^n (1-q)^{t-n}(1-S)^n SCR(t)}{\left(1+r(t+1)\right)^{t+1}} = CoC\sum_{t=0}^{T-1}\frac{SCR(t)\times\lambda(t)}{\left(1+r(t+1)\right)^{t+1}}$$

$$with\ \lambda(t) = (1-q\cdot S)^t = (1-CoC\cdot S)^t$$

  - **Case (3)**. No further stress is assumed to occur

$$\sum_{t=0}^{T-1}\frac{(1-q)^t q SCR(t)}{\left(1+r(t+1)\right)^{t+1}} = CoC\sum_{t=0}^{T-1}\frac{SCR(t)\times\lambda(t)}{\left(1+r(t+1)\right)^{t+1}} \quad with\ \lambda(t) = (1-CoC)^t$$

Practical application to different risks

- One possible approach: interpret which Case might apply based on specification for risk given in SII Standard Formula. Some ambiguity but maybe supports following (for selected life insurance risks):

Risk (SCR module)	Likely relevant Case (and likely range for *S*)	Comment
Market risk	Case (2), *S* maybe between c. +0.1/+0.2 and +0.59	Usually assumed hedgable so usually mostly excluded anyway
Counterparty default risk	Case (2), *S* positive but typically less than for market risk	
Mortality risk	Perhaps close to Case (3). At least Case (2) with *S* = 0.15	Stress explicitly applied at all future valuation dates
Longevity risk	Again between Case (2) (but *S* negative = -0.2) and Case (3)	
Expense risk	Arguably close to Case (3)	Stress applied to all future valuation dates
Mass lapse risk	Case (2), typically with *S* = 0.4 or sometimes higher	
Operational risk	Case (1)	Little indication that risk occurrence in one year should impact later years

Overall results

- Typically justifies an attenuation pattern $\lambda(t)$ for **life insurance risks** somewhere between $1^t = 1$ and $(1 - CoC)^t = 0.94^t$
  - No obvious reason to impose a floor for large t
  - C.f. EIOPA HIA proposal has $\lambda(t) = \max(0.975^t, 0.5)$
- AAE (2019) refers to a possible **non-life counterexample** likely to exhibit positive autocorrelation, i.e. a liability risk like asbestos
  - Standard formula specification for this sort of risk is premium related, so typically shouldn't change (given the above formulation) conditional on number of previous stresses that have happened, i.e. an example of Case (1)
  - But intrinsic features of risk perhaps imply Case (1) would be too optimistic
- More generally, relying solely on standard formula specification may be unreliable. Its stresses were not formulated with this specific use in mind

Other comments

Intrinsic nature of different risks

- Non-life liability
  - Approach just focusing on standard formula risk specification arguably would understate the 'intrinsic' market consistent RM
- Other risks?
  - Operational risk: maybe zero attenuation too cautious as past occurrences might incentivise future improvements, or maybe the opposite if hidden control weaknesses are coming to light
  - Many commentators think longevity risk shares similarities with mass lapse risk ("can't cure the same cancer twice")
  - Most non-life risks where standard formula SCR specification refers only to premium income but where risk might also link to claim amounts tend to be relatively short-term, i.e. long-tail liability risk may be an outlier
- Overall, some average attenuation across the whole industry may be plausible, given higher average duration of life insurance liabilities

Internal models and undertaking-specific parameters

- Suppose we don't think a **single** $\lambda(t)$ is appropriate
- Some firms use an internal model to set their SCR
  - Could allow such firms to include a $\lambda(t)$ in their internal model, potentially varying by risk type
  - Models are subject to prior regulatory approval and other governance disciplines
  - In effect broadens scope of an internal model to include the most appropriate $\lambda(t)$ to apply to the SCR in the RM calculation (as well as the SCR itself)
- Non-internal model firms
  - Could introduce equivalent via undertaking-specific parameters (USPs)
- Could extend ORSA SCR appropriateness to cover RM appropriateness
- Attenuation is linked to a 'loss absorbing capacity of RM'

Summary

- **SII RM calculation is a major issue for some insurers (particularly life insurers with long duration liabilities)**
  - EIOPA HIA proposal includes an attenuation factor, $\lambda(t)$
- **Can apply market consistent principles to the problem**
  - Attenuation factor ideally depends on size of stress conditional on what stresses have occurred before. For life insurance risks, typically supports $\lambda(t)$ somewhere between $1^t = 1$ and $(1 - CoC)^t = 0.94^t$, without a fixed floor. EIOPA HIA proposal has $\lambda(t) = \max(0.975^t, 0.5)$
- **Standard formula SCR specification can inform suitable $\boldsymbol{\lambda(t)}$ but only imperfectly**
  - E.g. an increasing $\lambda(t)$ for some non-life liability risk rather than a flat $\lambda(t)$?
- **If a single $\boldsymbol{\lambda(t)}$ is considered inappropriate?**
  - Expand internal models (or USPs) to include $\lambda(t)$? Extend ORSA SCR appropriateness to cover RM appropriateness?

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Thank you for your attention

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