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Considerations on the Discount Rate in the Cost of Capital method for the Risk Margin

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Introduction

- What this session is about:
  - The Discount Rate in the Cost of Capital Method as proposed under Solvency II.
  - The assumptions underlying the Cost of Capital of the method.
  - Some undesirable properties of this method
  - How these issues can be solved.
- What this session is NOT about:
  - The validity of the method in its entirety.
  - How to project Capital in the Cost of Capital Method.
  - How to project Cost in the Cost of Capital Method.

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Introduction

- Why is it Important
  - The Discount Rate has a profound impact on the Risk Margin under the proposed method *for Liabilities with a very Long Duration.*
  - The Proposed method can lead to a material overestimation of the Risk Margin for such Liabilities

Summary CoC Method

The Cost of Capital Method:

1. Project future amounts of Solvency Capital Requirement (SCR) per annum.
2. Take 6% of each future annual SCR.
3. The Risk Margin *RM* equals the present value of the amounts under 2 discounted at the risk free rate.

$$RM = \sum_{i=1}^{n} SCR(i\text{-}1) \times 6\% / [1 + r_f(i)]^i \,.$$

A simple example

SCR held constant until infinity:

– SCR(t) = 100 for all $t \geq 0$.

The risk margin is now a perpetual annuity with annual payment 6, and a risk free discount rate of, for example, 2%:

$$RM = \sum_{i=1}^{\infty} \frac{6}{1.02^i} = 6 \sum_{i=1}^{\infty} \frac{1}{1.02^i} = \frac{6}{2\%} = 300!$$

A simple example

Hence the 'Cost of Capital' of holding 100, until infinity, is 300!

However

- No rational economic agent would require upfront compensation of 300 to run the risk of losing 100.
- The maximum pay-out under the contract(s) may well be below the level of the risk margin, which means the insurance premium to be charged is in excess of the maximum coverage provided.
- When the discount rate approaches 0, the risk margin approaches infinity!

It’s not the Law!

The Level 1 Directive of Solvency II states the following (article 77 section 5):

The risk margin shall be calculated by determining the cost of providing an amount of eligible own funds equal to the Solvency Capital Requirement…

In an economic sense, the cost of providing an amount of SCR is:

The value of the SCR provided now -/-
The present value of any return of that capital at a later date.

⇨ The second term is always non-negative, so:
The Risk Margin should never be higher than the amount of SCR provided!

This holds true regardless of the discount rate used in the present value.
NB there is no requirement to put up additional own funds at a later stage.

Another Perspective

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Suppose two investments have the following pay-outs:

	Investment 1: Stock in Insurance Company Expected profit €6 per annum	**Investment 2**: German Government bond Fixed Coupon: €6 per annum
Year 1	€6	€6
Year 2	€6	€6
Year 3	€6	€6
Year 4	€6	€6
Year 5	€6	€6
Year 6	€6	€6
Year 7 etc.	€6	€6

Which investment is worth more today?

The PV of investment 1 is the Risk Margin, only for Investment 2 the risk free rate applies.

Recap: Some Desirable Properties of the Risk Margin

1. The Cost of Capital should be no higher than the Capital itself.

Otherwise an arbitrage opportunity would occur. An investor can invest SCR to receive compensation worth more than SCR.

2. The Risk Margin should be no higher than the highest possible value that the Risk can attain.

Also known as the 'no-rip off' premium principle. The upfront price of the risk should be no higher than the highest possible value that it can attain.

The Cost of Capital Method violates these properties!

What is the right Discount Rate?

Let *r* be the discount rate to be used in the CoC method.

Assume (for now) the risk free rate =0.

Let again SCR = 100 for all t ≥ 0:

RM = $\sum_{i=1}^{\infty} \frac{6}{(1+r)^i} = \frac{6}{r}$, a perpetual annuity.

In order to have that RM ≤ SCR, we need: $r \geq 6\%$.

In this case the investor simply puts in 100 at the beginning and never gets it back. What is an adequate compensation for his loss?

Discount Rate

– 6 at the end of each year, until infinity, OR:

– 100 at time t=0. In this case his loss is immediately compensated.

A 6% return to the investor is just sufficient as compensation for the risk he incurs, and so he is indifferent between both options.

Hence:

$\frac{6}{r\,\%} = 100 \Rightarrow r = 6\%.$

The Risk Free Rate

- So far we have assumed a risk free rate equal to zero. Assuming a zero risk free rate requires a discount rate in the CoC formula of 6%
- For any positive risk free rate r_f the discount rate could be r_f + 6% and RM will be lower.
- However using a positive risk free rate, RM is no longer invariant under the choice of time unit.
- For example switching from years to months will change the value of RM, as the ratio of *'required rate of return'* : r_f will change.

Discount Rate - Recap

In the CoC formula, a discount rate equal to the required rate of return (6%), is the only discount rate that ensures that:

– RM ≤ SCR

– In case SCR = constant until infinity, RM = SCR

– RM does not depend on the choice of time unit, e.g. months, years, decades.

If the discount rate < 6%, then we can have that RM > SCR.

RM > SCR can also occur if the time horizon is finite, and has been the case for various real insurers under the proposed methodology.

The original idea

- Project SCR(t) in all future periods *t*.
- Hold a Risk Margin from time t=0
- Invest the Risk Margin at the risk free rate, such that in each future year, the release from the Risk Margin is equal to 6% * SCR(t).
- The risk margin now is the present value of the 6% of SCR(t) discounted at the risk free rate.

HOWEVER

The Risk Margin Conundrum

- The original idea starts from having to hold SCR against unexpected increases (shocks) in payments to policyholders:

SCR= Present Value of: Worst case Cash Flow -/- Best Estimate Cash flow.

- By adding the risk margin to the liability, the total buffer available to protect policyholders increases.
- But the SCR in itself already provides an adequate buffer by the standards used to define it. As the level 1 text of Solvency II states, the SCR is the amount of own funds *'necessary to support the insurance and reinsurance obligations over the lifetime thereof'.*

What does it imply?

After adding the Risk Margin, the total buffer available to cushion unexpected losses increases to *SCR + RM.*

This implies either one of the following:

1) The maximum amount of unexpected loss can exceed the SCR, and the extra buffer provides extra protection for policyholders as well as investors.

OR

2) SCR is the maximum amount of unexpected loss that can occur, and the addition of the risk margin provides an extra buffer ***only*** *for the investor thus reducing his risk (but the required return remains the same).*

1 or 2?

Which of these assumptions is consistent with the assumptions underlying the CoC method? *(and which ones are true?)*

Assumption 1 and 2 are mutually exclusive: either the SCR is the maximum possible unexpected loss or it is not.

For many risks, the theoretical maximum loss is far in excess of the SCR.

If 1 is true, then the level of protection for policyholders is over and above the amount originally intended by setting the SCR, especially if RM = 3 times SCR! This is nevertheless a Dutch treat, as the policyholders will have to provide the Risk Margin to begin with.

If 1 is not true but 2 is true then an amount SCR- RM of the SCR is actually not exposed to risk, so the risk is reduced for the capital provider.

1 or 2?

Instead of ‘What is true’ we need to ask: which assumption corresponds with the underlying assumptions of the Cost of Capital method -

and is true by approximation.

For the purpose of valuation we are assuming:

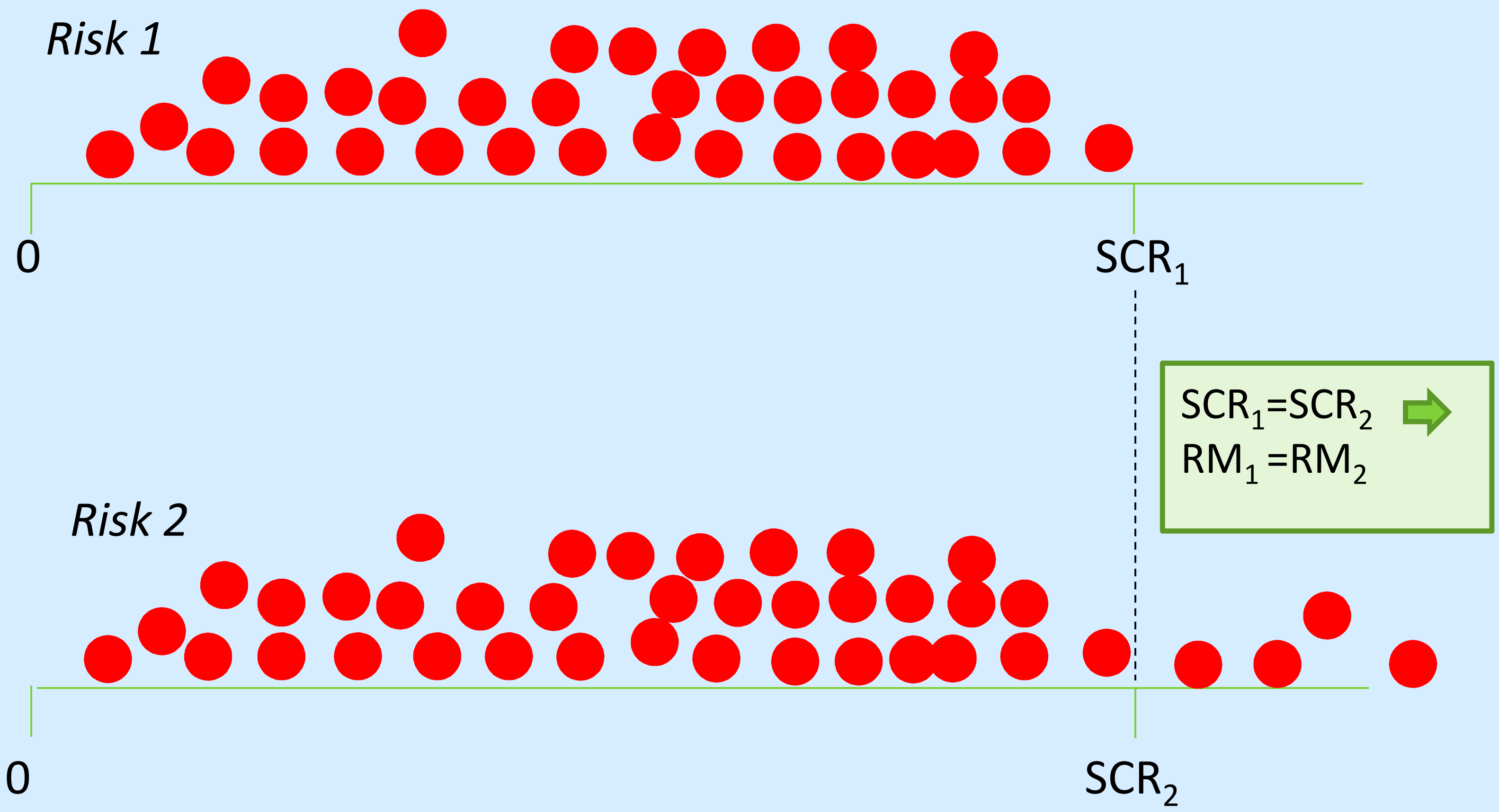
- The SCR provides an adequate buffer before adding the risk margin. The investor provides no more than this amount and is under no obligation provide additional funds. =>

- The possible occurrence of any scenario in which the unexpected loss exceeds the SCR does not impact the Risk Margin. =>

- For the purpose of valuation we must assume 2 to be true: the unexpected loss can not exceed the SCR. The likelihood of more severe scenarios is deemed negligible.

Consider two almost identical risks, Risk 1 & Risk 2:

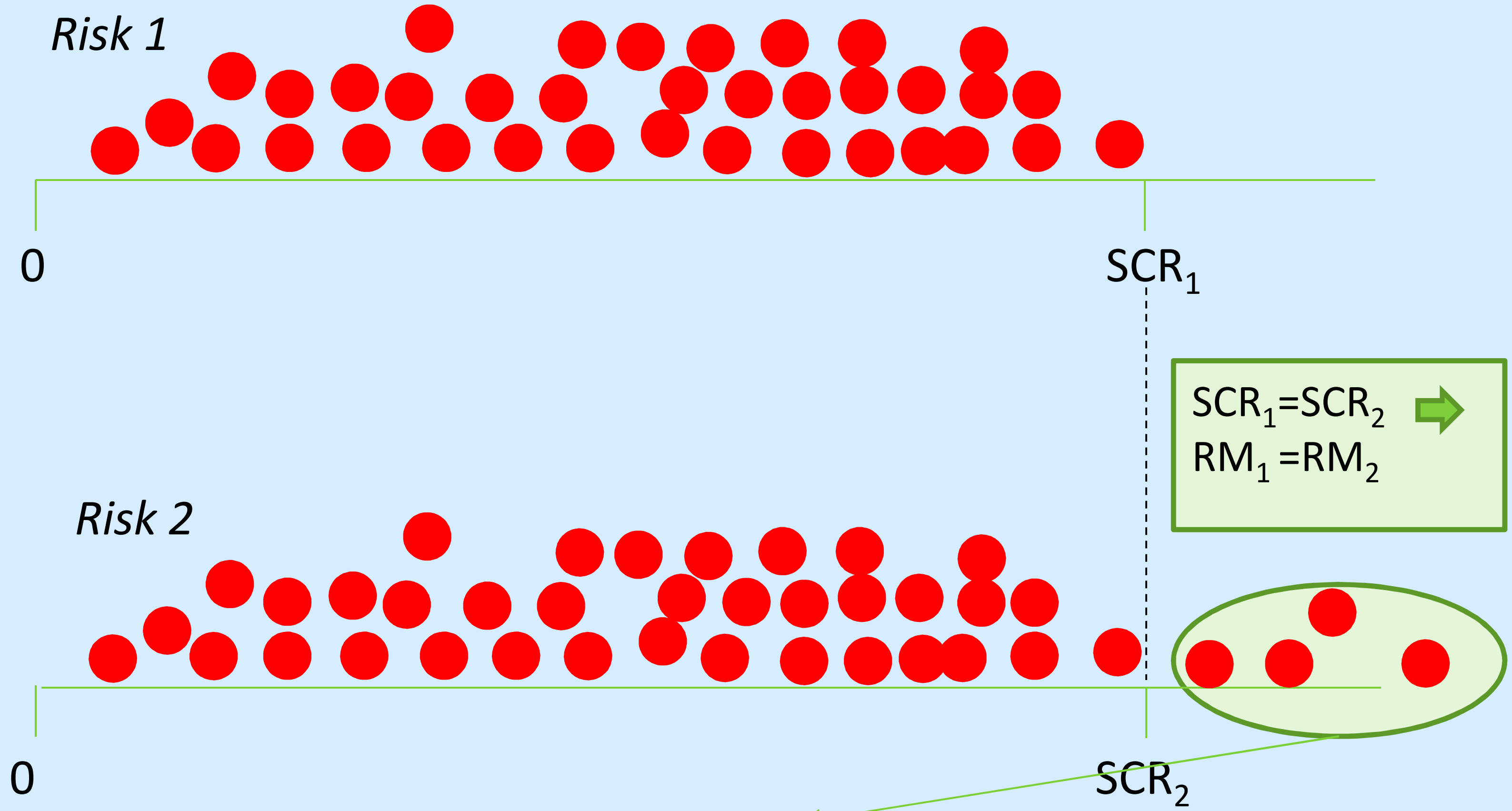
● = *Possible value of Risk*



The two risks carry the same SCR and so have the same risk margin: $RM_1=RM_2$

Consider two almost identical risks, Risk 1 & Risk 2:

● *= Possible value of Risk*



The scenarios of Risk 2 greater than SCR_2 have no impact on the Risk Margin ➡
In the valuation of the risk, they are assumed not to exist.

1 or 2?

Hence for the purpose of valuation of the risk we are assuming:

The SCR is the highest possible unexpected loss that can occur →

Of the total buffer of SCR +RM, an amount RM is (assumed) not to be exposed to risk.

If total capital of SCR + RM is needed to provide adequate protection to policyholders, then the SCR itself should be increased accordingly. The RM is meant as compensation to the investor.

Derivation of the Risk Margin

Recall SCR represents the (PV of) the worst case shock in future cash flows.

Define SCR’ = SCR- RM.

Holding an amount of capital SCR’ instead of SCR provides adequate protection to policyholders, as RM is held as additional buffer.

After the worst case shock in the amount of SCR has occurred, the maximum has been reached and no further losses are assumed possible.

Even if an amount of capital equal to SCR is held, an amount SCR – SCR’ =RM thereof is not exposed to risk.

=> Therefore the cost of capital should be charged over SCR’ and not SCR!

Derivation of the Risk Margin

The simplest case:

Risk free rate =0,
Time horizon = 1 year.

Then we have to solve:

SCR’ + RM = SCR
RM = 6%* SCR’ =>

SCR’ = 1/1.06 * SCR ,
RM = 6%/1.06 * SCR

RM is 6% of SCR discounted at 6%.

Derivation of the Risk Margin

Extend to:

Risk free rate =0,

Time horizon = Any period $t > 0$.

SCR = Constant over the entire period.

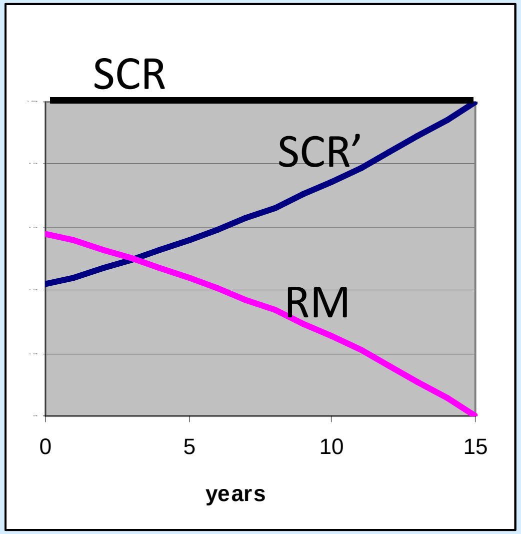
*1 year: RM = 6%/1.06 * SCR*

Then simply replace the 6% by its multiyear equivalent 1.06^t *-1:*

$$RM = (1.06^t - 1)/\ 1.06^t * SCR$$

$$= (1 - 1.06^{-t}) * SCR$$

$$= SCR \sum_{i=1}^{t} 6\%/1.06^i \quad \text{for integer values of } t.$$



Derivation of the Risk Margin

In the paper it is shown that:

- The example can easily be generalized for any Run-off pattern of SCR over multiple periods.
- If the Risk free rate is positive instead of 0, the Risk Margin becomes lower. In this case the Risk Margin becomes dependent on the choice of time unit.

- The assumption of a zero risk free rate is most workable, and always leads to a higher Risk Margin than a positive risk free rate.

- The general formula for the Risk Margin now becomes:

$$RM = 6\% \times \sum_{i=1}^{n} 1/(1+6\%)^{i} \times SCR(i\text{-}1)\ .$$

Properties of the Risk Margin

$$RM = 6\% \times \sum_{i=1}^{n} 1/(1+6\%)^{i} \times SCR(i-1)\ .$$

This Risk Margin satisfies the following properties:

- RM ≤ SCR at any point during run-off.
- If SCR = Constant until infinity, then RM = SCR.
- RM is invariant under a change of the time unit and can be determined at any point in time, not just at the end of a year.
- RM provides a return to the investor of 6% per year over SCR'= SCR- RM, the amount exposed to risk according to underlying assumptions.
- The total of RM and risk bearing capital SCR' is sufficient to absorb the worst case shock as originally calibrated.

Further Thoughts- DCF

- If you think the formula looks like Discounted Cash Flow, that's because it is!
- We are taking the point of view of an investor providing an amount of capital and requiring a given rate of return.
- Then we are projecting the *expected* cashflows to and from the investor to determine the upfront value of the risk over the entire period.
- The idea is no different than a regular DCF method.

Further Thoughts- DCF

- Recall the formula:

$$RM = SCR - 1.06^{-t} * SCR = SCR \sum_{i=1}^{t} 6\%/1.06^{i}$$

  – *SCR* is the amount put in by the investor at time *t*=0,
  – 1.06^{-t} * *SCR* is the PV of the return of the capital to the investor at the end.
  – These equalities only hold if *required return = discount rate.*

- Then why not discount the liability cashflows directly at then required rate of return?
- The liability cash flows are negative from the investor's point of view=> A higher discount rate means a lower value of the liability and DCF is not suitable.

To Conclude

- The use of the risk free discount rate in the CoC method leads to an inconsistency between SCR and RM, based on the underlying assumptions of the method.
- In particular, RM can become greater than SCR for long durations.
- Using the required rate of return, in excess of the risk free rate, as the discount rate, removes the inconsistencies discussed.
- The proposed method is equivalent to DCF.

Further Thoughts- Shocks to RM

- The SCR (used as input for the CoC method) is based on a shock to cash flows, not to market values or the Risk Margin itself. =>

- It is assumed implicitly that the Risk Margin with or without the shock is the same.
- If this assumption is not true, then the level of capital required to fund the market value over a limited time horizon, e.g. 1 year, may be understated to some degree.
- If this assumption is not true then SCR and RM are mutually dependent on one another, which requires a much more complex modelling approach.

⇒ **By using the CoC method we are assuming that no (material) unexpected change in the value of the risk margin can occur**.

The CRO Forum comments as follows on this issue:

Given the relative size of the MVM in comparison to the total MVL the impact of including the MVM in the SCR calculation would be insignificant. Drawing on this observation, the assumption is made that the MVM will have little or no effect on the SCR and can therefore be excluded from the SCR calculation.

A real life example

Life Insurance Company

Duration = 16

SCR = 861

RM = 888 using risk free discount rate.

RM = 429 using 6% discount rate

SCR' = 432.