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Risk Margins and Solvency II

Peter England and Richard Millns

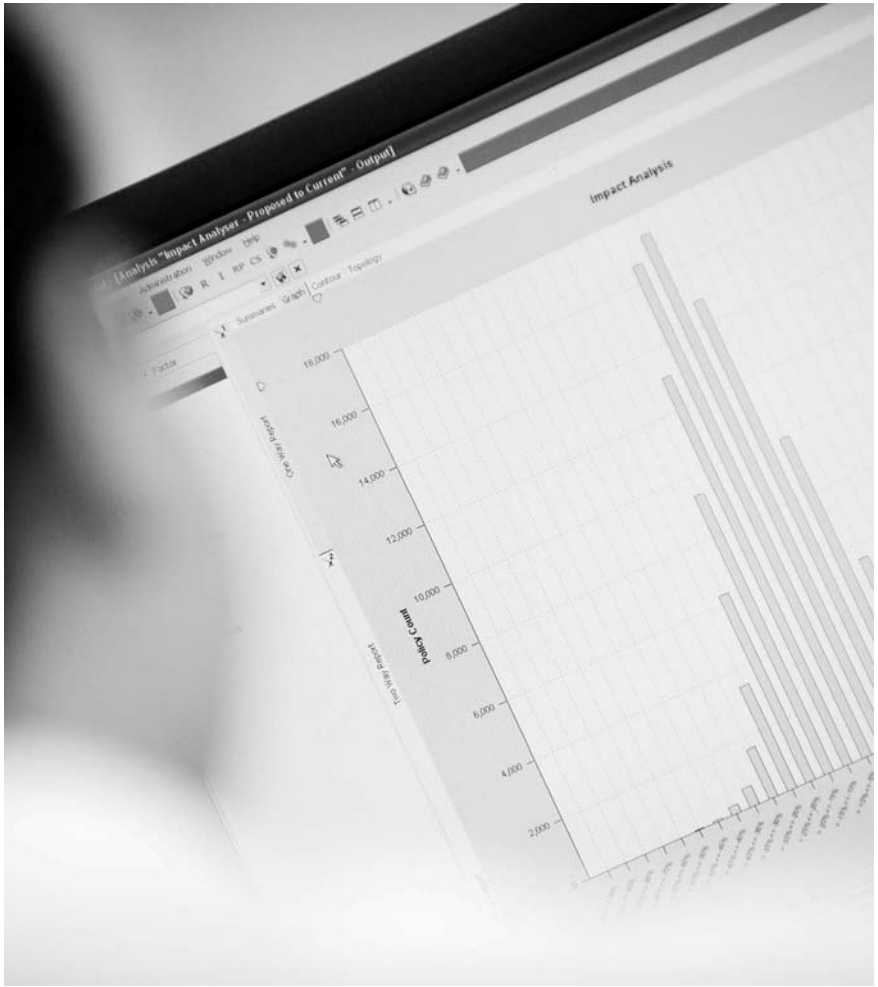
GIRO conference and exhibition

Liverpool, 11-14 October 2011

Agenda

- Part 1 – A quick re-cap from last year (and the year before)
- Part 2 – Further thoughts
- Part 3 – An example model

Note: This presentation only considers risk margin calculations in respect of simulation-based internal models



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A quick recap from last year (and the year before)…

Czernuszewicz, AJ, and England, PD (2009). *The Ultimate and One-Year Views of Reserving Risk with Respect to Solvency and Risk Margins*. GIRO presentation.

England, PD, and McGuinness, A (2010). *Solvency II Balance Sheets in Simulation-Based Capital Models*. GIRO presentation.

DIRECTIVE OF THE EUROPEAN PARLIAMENT
Article 101

"The Solvency Capital Requirement shall be calibrated so as to ensure that all quantifiable risks to which an insurance or reinsurance undertaking is exposed are taken into account. With respect to existing business, it shall cover unexpected losses.

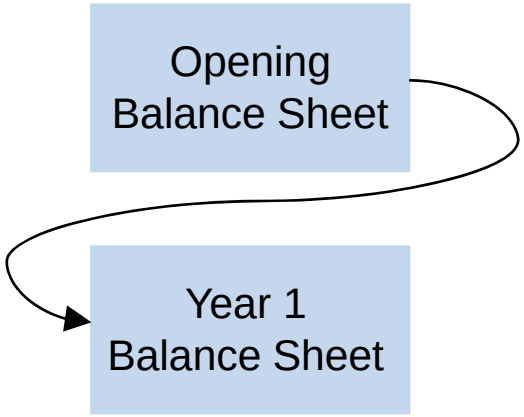
It shall *correspond* to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99.5% over a one-year period."

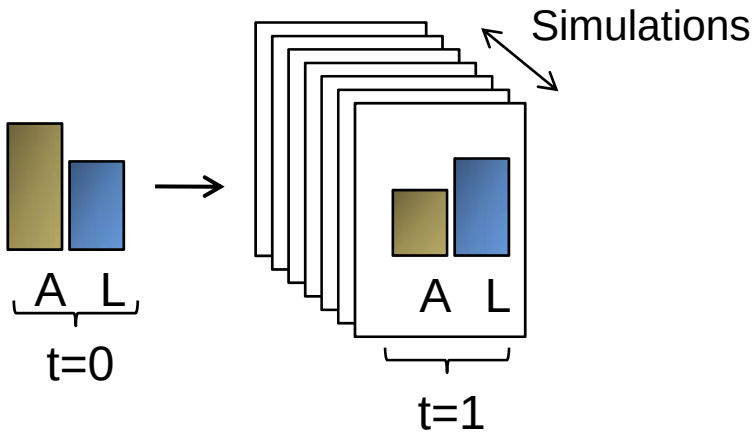
So it seems straightforward to estimate the SCR using a simulation-based model: simply create a simulated distribution of the basic own funds over 1 year, than calculate the VaR @ 99.5%.

"The devil is in the detail…"

A Projected Balance Sheet View

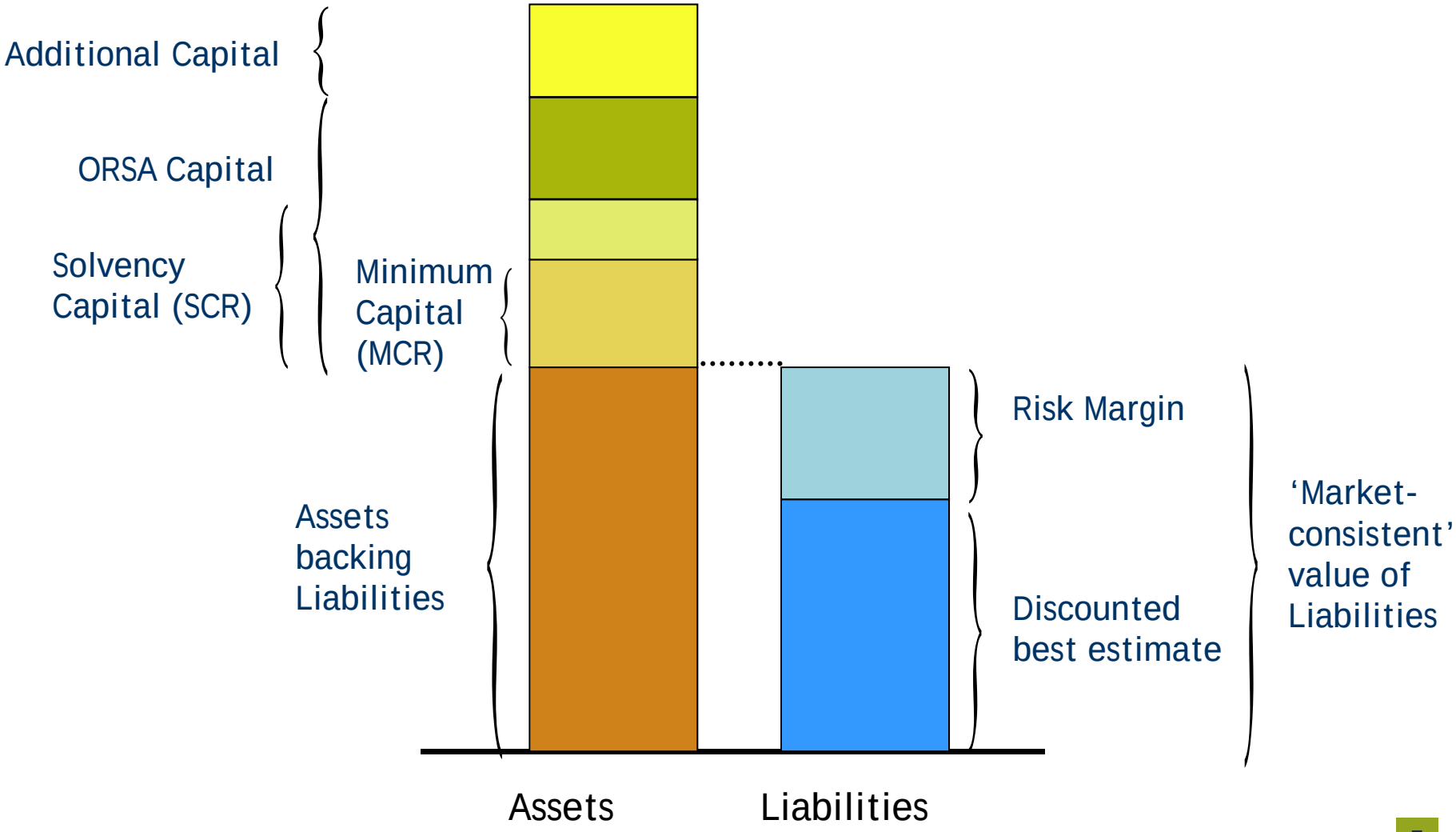
- From Article 101, the SCR is calculated from a distribution of net assets over a 1 year time horizon
- When projecting Balance Sheets for solvency, we have an opening balance sheet with expected outstanding liabilities
- The bulk of those liabilities are the “reserves” (provisions) set aside to pay unsettled claims that have arisen on policies sold in the past
- We then project one year forwards, simulating the payments that emerge in the year, and require a closing balance sheet, with (simulated) expected outstanding liabilities conditional on the payments in the year, together with the market value of assets at the end of the year





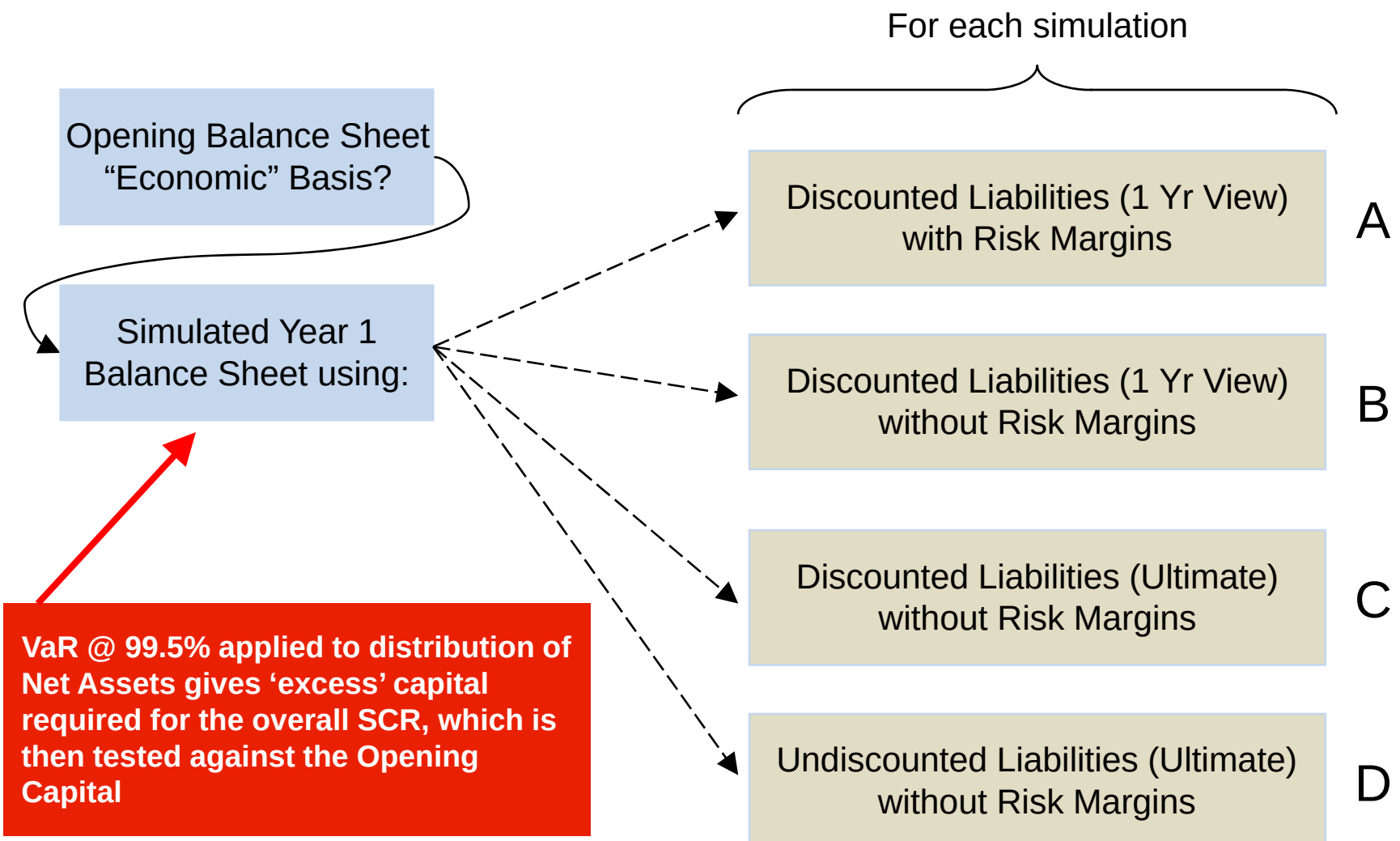
Solvency II Balance Sheet

In the usual course of business…



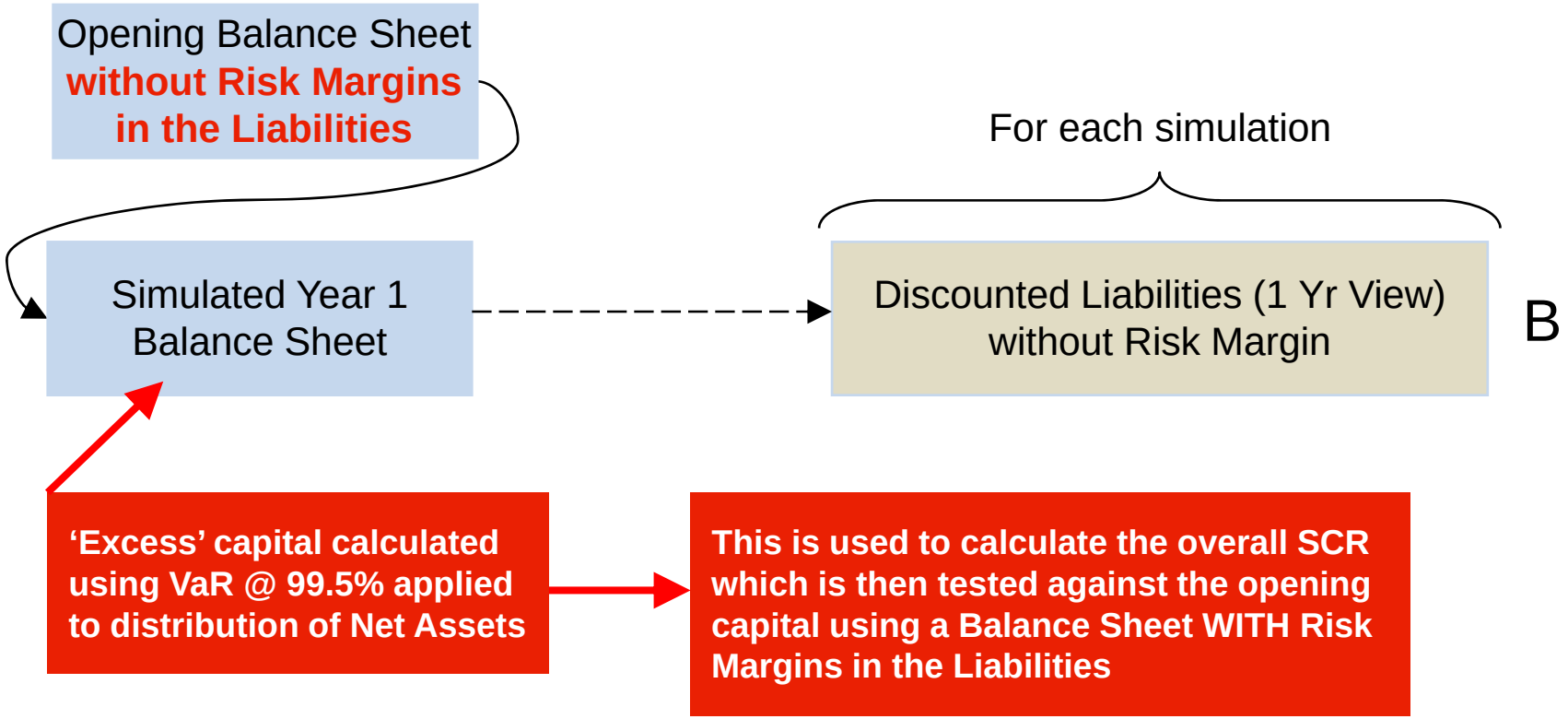
Overall SCR

GIRO 2009: Simulated Year 1 balance sheet options



Simulated balance sheet definitions after 1 year?

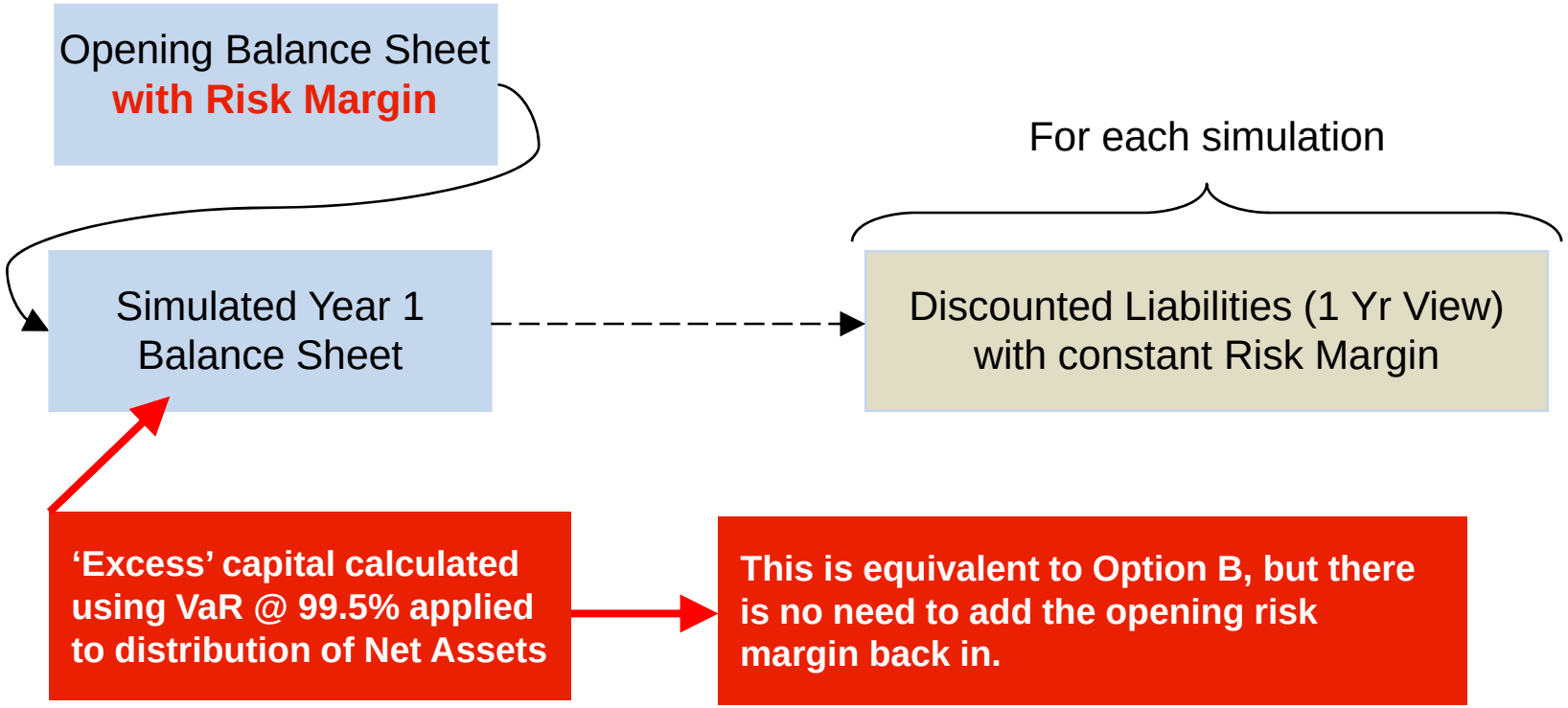
GIRO 2009: A convenient procedure



Under what assumptions can we use a balance sheet definition without risk margins in simulation based internal capital models for calculating the overall SCR?

Simulated balance sheet definitions after 1 year?

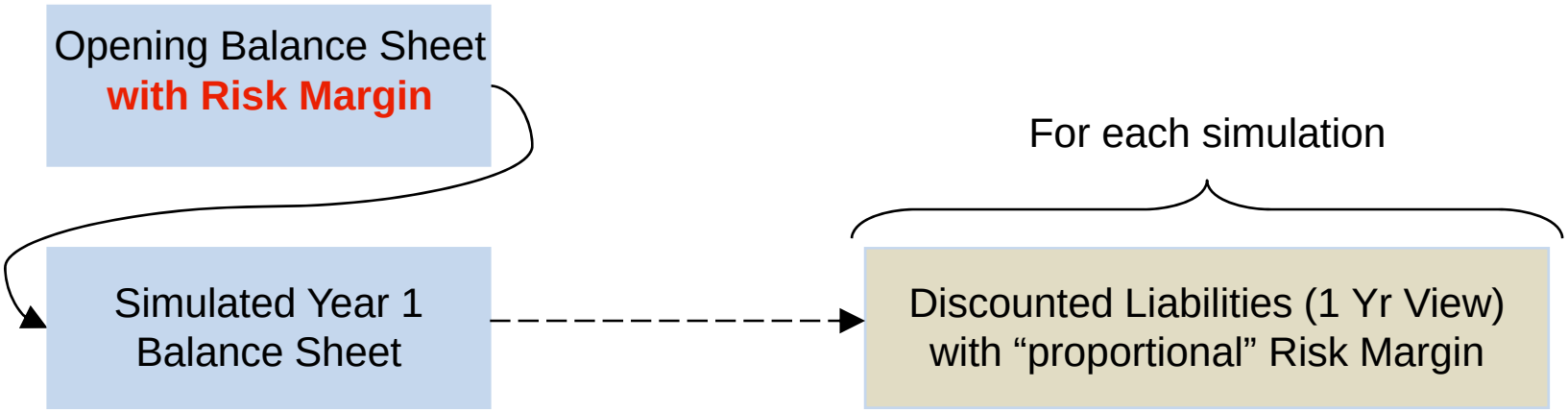
GIRO 2010: Simplification 1 - Constant Risk Margin



Using a constant risk margin appears to be analogous to the assumptions underlying the QIS 5 standard formula (that is, the change in the risk margin is not considered)

Simulated balance sheet definitions after 1 year?

GIRO 2010: Simplification 2 - “Proportional” Risk Margin



GIRO 2010:

“We could devise more complicated alternatives based on “proportions” where the risk margin is different for each simulation, giving the appearance of a better solution”

The Important Question

- When calculating risk margins, it is impossible to satisfy the Solvency II requirements without simulation on simulation, which is impracticable
- Simplifications must be made
  - When calculating the opening SCR for the risk margin calculations
  - When calculating future SCRs
- Simplifications must be made for risk margins for each simulation on the 1 year ahead balance sheet
  - Assume a constant risk margin?
  - Use a simple ratio method?
- What we don't know is: "What methods will be approved?"
- The question can only be answered by the regulators, so we asked the FSA

What the FSA has said so far…*

- "At present there is no definitive answer"
- "We don't want to give an answer that turns out to be wrong"
  - QIS 5 is not final: it is only a test
- "Do something sensible and explain why it's sensible"
- "Worry more about the technical provisions; the risk margin will usually be a lot smaller"
  - "Proportionality" should be borne in mind

** Reported at GIRO 2010*

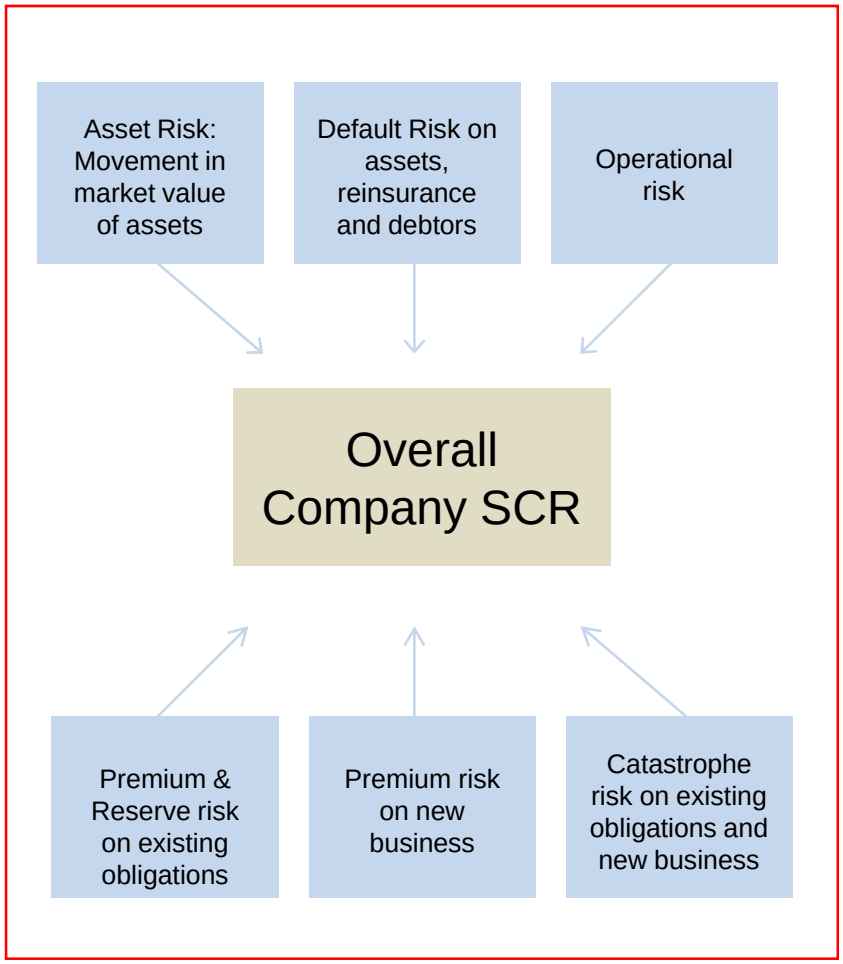
“Do something sensible, and explain why it is sensible”

So, this presentation considers how to obtain an “opening” risk margin for a Solvency II balance sheet from a simulation-based internal model, and also how to allocate that to line-of-business at the same time in a consistent way.

It also considers how to obtain simulated risk margins for the 1-year ahead balance sheet by line of business and in total, using the same outputs.

Solvency Capital Requirements

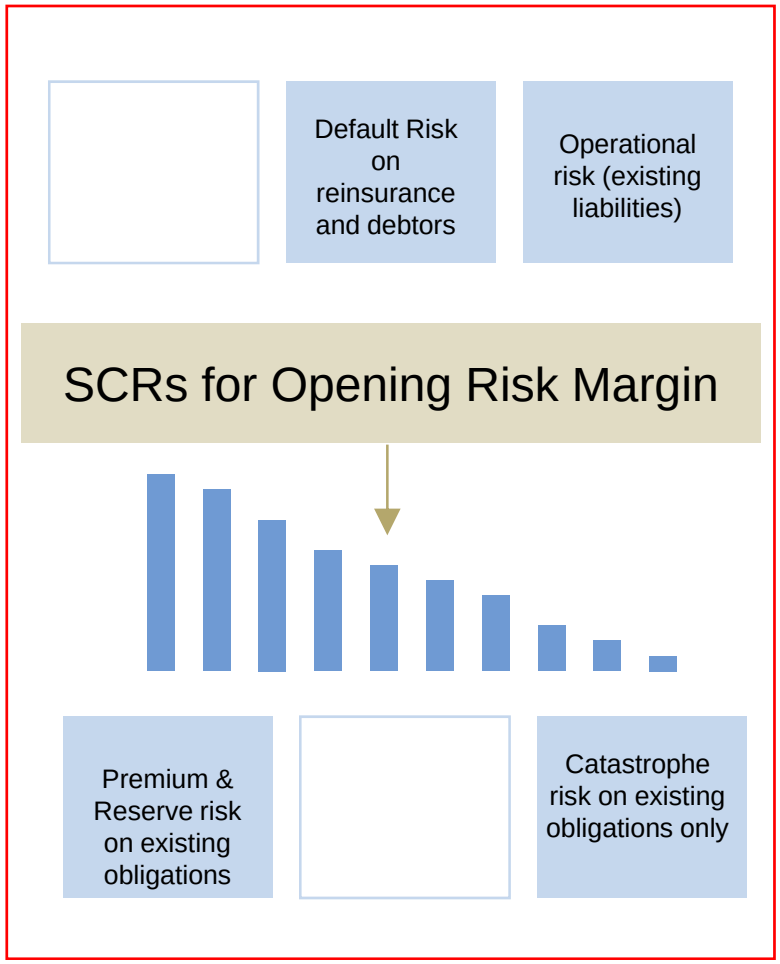
Non-Life Companies



The Risk Margin

- The risk margin is designed to ensure that the value of technical provisions is sufficient for another insurer to take over and meet the insurance obligations
- It is calculated by determining the cost of providing an amount of eligible own funds equal to the SCR necessary to support the obligations over their lifetime
- Approach
  - Establish net best estimate technical provisions at each point over the lifetime of the liabilities
  - Estimate the appropriate corresponding SCR at each point
  - Apply the cost-of-capital charge factor
  - Discount and sum
- It is calculated at the portfolio level, net of reinsurance only
- The risk margin should take into account underwriting risk, reinsurer default risk, operational risk and ‘unavoidable’ market risk
- In practice for most non-life insurers, market risk can be ignored

Solvency Capital Requirements: Non-Life Companies



Calculating the Risk Margin

TP5.9

$$COCM = COC.\frac{\sum_{t\geq 0} SCR_{RU}(t)}{(1+r_{t+1})^{t+1}}$$

where

COCM = risk margin for the whole business

COC = cost of capital rate

$SCR_{RU}(t)$ = the SCR for year t as calculated for the reference undertaking

r_t = risk-free rate for maturity t

Risk Margin Example

Time	Best-Estimate Reserve	(SCR) Capital	Capital Charge (assuming 6% CoC rate)	Discounted Capital Charge (assuming flat 2% discount rate)
0	100	20	1.2	1.18
1	60	15	0.9	0.87
2	40	10	0.6	0.57
3	20	4	0.24	0.22
4	10	3	0.18	0.16
5	5	1	0.06	0.05
Total	-	-	3.18	**(Risk Margin =) 3.05**

Risk-Margin

Granularity

- The risk margin assumes transfer of all business, hence it can allow for diversification between all reserve elements, including lines of business
- However, “technical provisions” need to be estimated at “class” level (own segmentation, or at least no higher than Solvency II LoB level)
  - Hence we need to produce risk margin at this level
  - Sum of class risk margins should equal the total risk margin
- So we need a way of allocating the overall risk margin to class

Calculating the Risk Margin by Line of Business

Possible Simplification TP 5.28

$$COCM_{lob} = \frac{SCR_{RU,lob}(0)}{\sum_{lob} SCR_{RU,lob}(0)}.COCM$$

where

$COCM_{lob}$ = *risk margin allocated to line of business*
$SCR_{RU,lob}(0)$ = *SCR of the reference undertaking for line of business at t=0*
$COCM$ = *risk margin for the whole business*

Notes:
1) The concept of an SCR by *lob* is a strange one, and appears to be a relic of QIS 4
2) Although it is not clear from the documentation, the SCRs should be in respect prior year reserves and legally incepted business only (but include an allowance for operational risk and reinsurance default risk).
3) Using this formula, there is no requirement for the sum of capital requirements across *lob*s to equal the total capital requirement

Requirements

- An overall SCR
  - Requires a distribution of the basic own funds after 1 year
- A risk margin on the opening balance sheet
  - Requires future SCRs in respect of the opening technical provisions only
- An allocation of the opening risk margin to LoB
  - Requires opening SCRs by LoB (in respect of the opening technical provisions only), at the very least
  - More robust methods require opening and future SCRs by LoB
- Simulated risk margins for the 1 year ahead balance sheet (for the overall SCR calculation
  - Just use a constant? (analogous to the standard formula approach)
  - Proportional to the simulated expected technical provisions at *T=1*?
  - Based on a cost-of-capital approach using future SCRs by LoB?

Desirable characteristics of a suitable method

- For the opening overall risk margin calculation, SCRs at each future period should recognise the changing profile of the liabilities (*i.e.* short vs long tailed)
- Opening risk margins by class should be "additive" to the overall risk margin (*i.e.* the allocation should be automatic)
- Simulated risk margins at *t=1, 2,…* should recognise new business written in the intervening periods (and the changing mix by class), and retain their additivity
- Simulated risk margins at *t=1, 2,…* should take account the (simulated) yield curve at each period

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The Opening Risk Margin

The Opening Risk Margin

- We require a risk margin for the opening balance sheet
  - This requires “SCRs” in respect of the opening technical provisions, for all future years
- How should those be calculated?
  - Using the standard formula?
  - Using output from the internal model?
- If an internal model is used for the overall SCR then it seems to make sense to use the output available where possible

The Opening Risk Margin in Internal Models

- First produce a suitable risk profile in order to calculate the initial SCR
- This should include the profit(/loss) over one-year arising from:
  - Prior year reserves and expenses
  - Unexpired risk and expenses
  - Legally obliged (but unincepted) business
  - Operational risk, RI default, and unavoidable market risk (not usually material)
- VaR @ 99.5% will give the opening SCR amount for the risk margin calculation
- Then calculate future SCRs:
  - In proportion to the emergence of the (expected) reserves in each future year in aggregate? By LoB?

Risk Margin – Future SCRs

QIS 5 Options

1. Make a full calculation of all future SCRs without using simplifications.
2. Approximate the individual risks or sub-risks within some or all modules and sub-modules to be used for the calculation of future SCRs.
3. Approximate the whole SCR for each future year, e.g. by using a proportional approach.
4. Estimate all future SCRs “at once”, e.g. by using an approximation based on the duration approach.
5. Approximate the risk margin by calculating it as a percentage of the best estimate.

Future SCR Calculation – An Approach

(For the opening risk margin)

1. Take the one-year profit/(loss) distribution of the net technical result by class for the existing business only as described earlier
2. Calculate the expected outstanding cash-flows by class for this business at each year end as the business runs off
3. Approximate the distribution of the profit/loss of the net technical result by class in future year *t* in proportion to the ratio of the expected outstanding cash-flows by class in future year *t* divided by the value at *t*=0*
4. Calculate the 99.5th percentile loss amount of the distributions in 3. to give the standalone SCR run-off by class before diversification. Call this $SCR(pre\text{-}div)^{RM}\ (0,class,t)$
5. Aggregate the loss distributions in each year *t* and calculate the 99.5th percentile to give the total SCR run-off over time. Call this $SCR^{RM}\ (0,t)$
6. Due to diversification, $SCR^{RM}\ (0,t)$ will typically be less than the sum of $SCR(pre\text{-}div)^{RM}\ (0,class,t)$ across classes. Hence scale $SCR^{RM}\ (0,class,t)$, such that $Sum_{class}\ (SCR^{RM}\ (0,class,t)) = SCR^{RM}\ (0,t)$. Note: alternative allocation approaches are possible.
7. Calculate the risk margin using the cost-of-capital approach at the class and total level (it will be additive, and will take account of the changing profile of the liabilities at the total level).

* In step 3 we could instead assume that the distribution scales in proportion to a function of the expected outstanding cash-flows e.g. square root

Assumptions

- The coefficient of variation of the one-year distribution around the expected technical provision (or function thereof) is the same at each year in the run-off within a class of business (proportional proxy)
- The dependency between classes is the same at each point in the run-off

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Example

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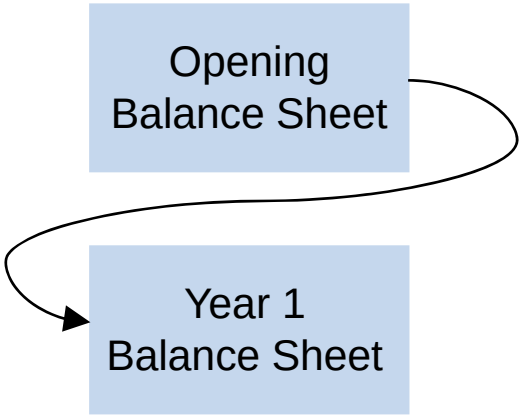
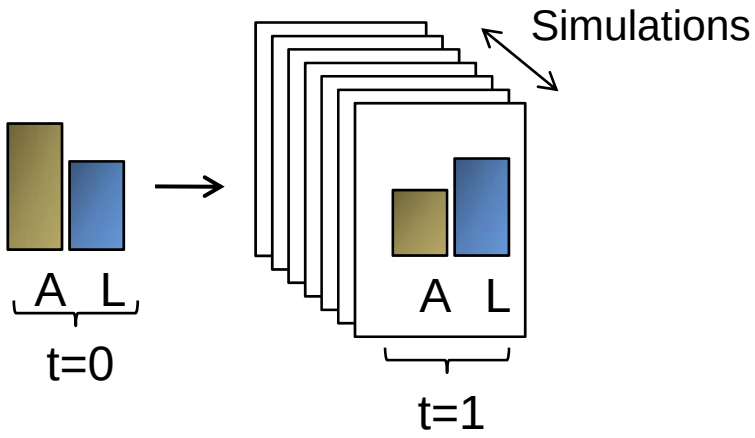
Risk Margins in the 1-Year Ahead Balance Sheets (and beyond?)

A Projected Balance Sheet View

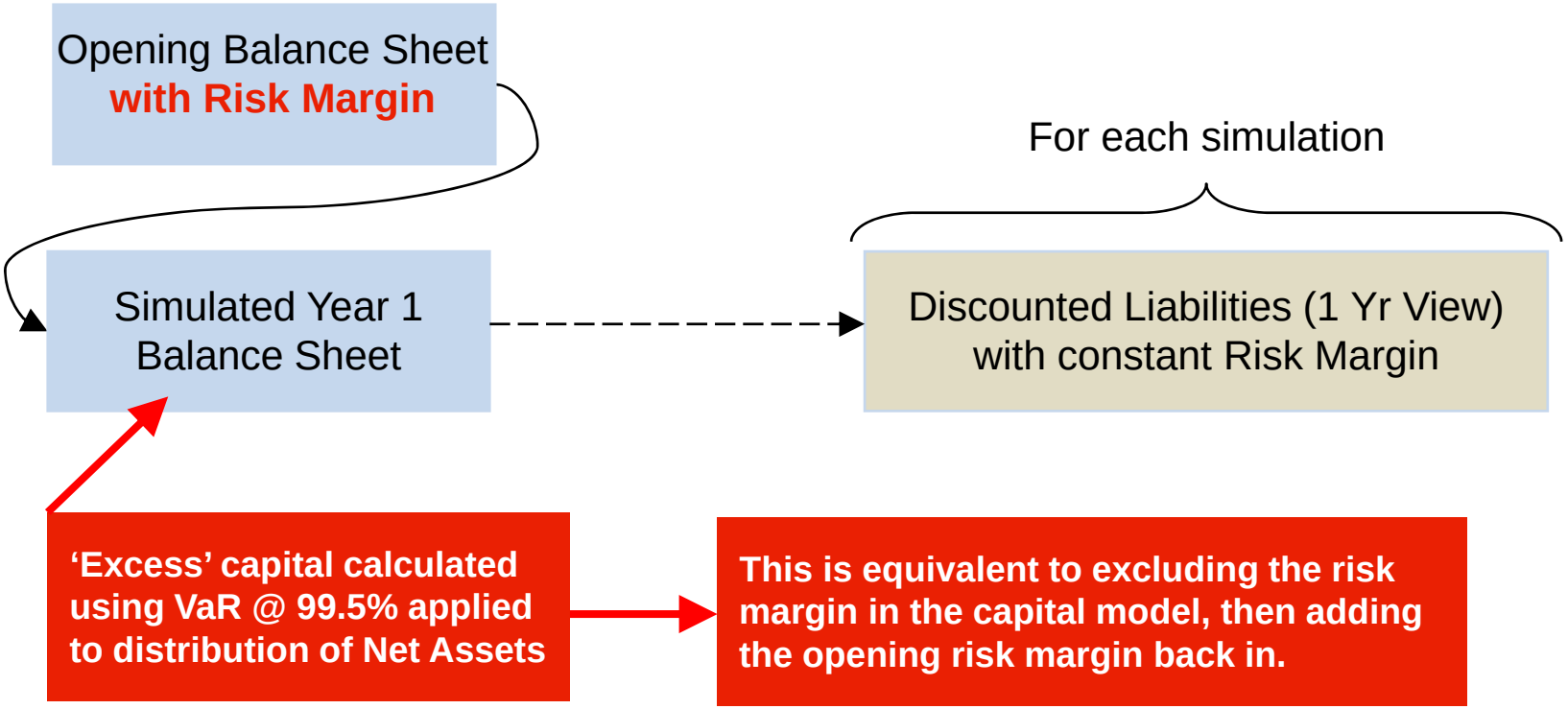
- Remember, from Article 101, the SCR is calculated from a distribution of net assets over a 1 year time horizon
- So when we project one-year forwards, in addition to the (simulated) expected outstanding liabilities conditional on the payments in the year, we also need a risk margin for each simulation, in respect of the outstanding liabilities at that time.





Simulated balance sheet definitions after 1 year?

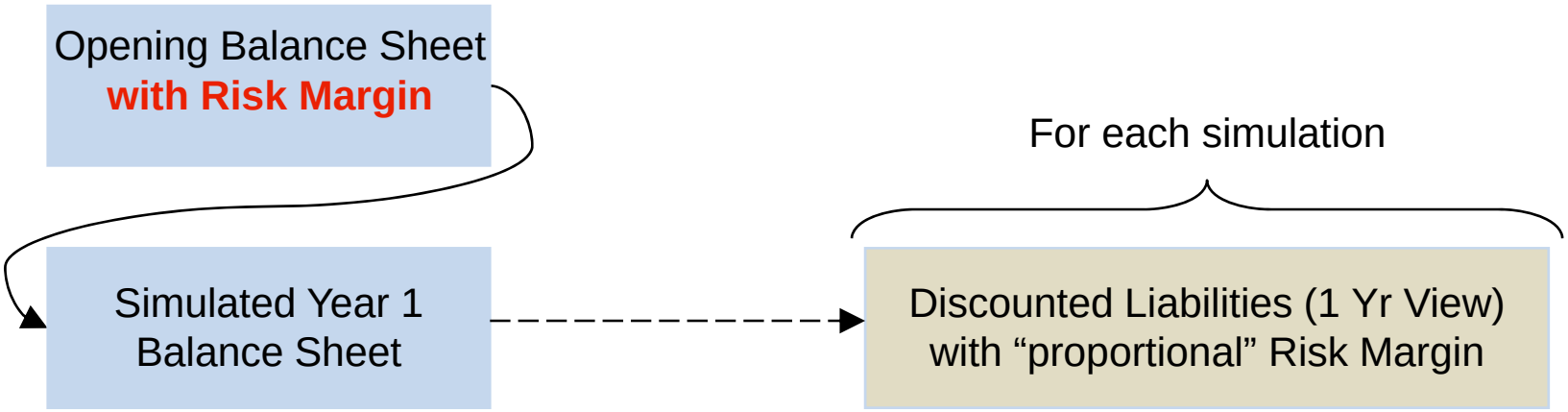
Simplification 1: Constant Risk Margin



Using a constant risk margin appears to be analogous to the assumptions underlying the QIS 5 standard formula (that is, the change in the risk margin is not considered)

Simulated balance sheet definitions after 1 year?

GIRO 2010: Simplification 2 - “Proportional” Risk Margin



GIRO 2010:

“We could devise more complicated alternatives based on “proportions” where the risk margin is different for each simulation, giving the appearance of a better solution”

Projection of the Risk Margin

Options

1. Fixed risk margin (i.e. set closing risk margin equal to the opening value)
2. Risk margin based on expected best-estimate closing reserves
3. Risk margin based on the simulated best-estimate closing reserves

For example, if the risk margin is set as a constant proportion of the reserves we would have:

	BE t = 0	RM t = 0	BE t = 1	RM t = 1		
				Opt 1	Opt 2	Opt 3
High			130	10	11	13
Average	100	10	110	10	11	11
Low			90	10	11	9

In this presentation, we are proposing a more complicated variation of options 2 and 3.

Projection of the Risk Margin

Project the risk margin to *t=1,2,3* etc. by using results from the *t=0* calculation and making some further assumptions:

1. From the opening risk margin calculations, express the SCRs by class as a proportion of the expected outstanding cash-flows for each year*, *i.e.* calculate SCR^{RM} *(0,class,t) / Expected Outstanding(0,t)*
2. For the one-year ahead risk margins, approximate the SCRs by class by multiplying the expected outstanding cash-flows** at *t=1* by the ratio calculated at step 1
3. Sum across classes to give the overall SCR^{RM} *(1,t)*
4. Calculate the risk margin using the cost-of-capital approach at the class and total level, using the (simulated) risk-free yield curve at t=1

Assumptions

- The same assumptions as for the *t=0* calculations, plus the following:
- The coefficient of variation of the one-year loss distribution (in each simulation) within a class at *t=1* is the same as at *t=0*
- The diversification between classes at each point in the run-off is the same at *t=0* and *t=1*

* Again, in step 1 we could instead assume that the distribution scales in proportion to a function of the expected outstanding cash-flows e.g. square root

** Based on the stochastic or deterministic reserves at *t=1*

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Example

Implementation in Internal Models

For the SCRs for the risk margin calculation, there are two implementation options:

1. Put the “plumbing” into the internal model to allow the risk margin calculations to be performed simultaneously with full model runs
   - Partition the net technical result from the full model into separate components for the existing obligations (including legally obliged business) and new business, making sensible assumptions in respect of catastrophe exposures, reinsurance and expenses
2. Use the existing internal model without modification, but perform additional runs just for the risk margin calculations
   - Modify the inputs so the model relates to the existing obligations only (including legally obliged business) excluding new business, making sensible assumptions in respect of catastrophe exposures, reinsurance and expenses

Summary

- There are many complications associated with risk margins under Solvency II:
  - Risk margins are required for the opening balance sheet, and for each simulation at the 1 year ahead position
  - Although a “diversified” risk margin can now be calculated under QIS 5, there is still a requirement to allocate the risk margin to line of business (TP5.26-5.28)
  - This requires an opening SCR, as well as future SCRs for the cost of capital method
- This presentation proposes a new approach to calculating the opening risk margin using outputs from an internal model, and also considers how the risk margins might then be calculated for each simulation at the 1 year ahead position.
  - The approach is simple and has many desirable characteristics

Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.