MILLIMAN RESEARCH REPORT

S2AV: A valuation methodology for insurance companies under Solvency II

October 2016

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1. Introduction

The goal of this paper is to discuss some of the challenges in valuing insurance companies under the Solvency II framework and to propose a possible valuation methodology to meet the needs of potential investors with a certain perspective in mergers and acquisitions (M&A) transactions. The methodology developed also has potential wider applications in insurance company management.

In the authors' experience, buyers and other users of insurance company valuations are often keen to understand the shareholder "cash flows," i.e., the expected real world distributable profits. In such cases buyers will generally want to discount these cash flows at the investor's required rate of return.

Traditionally this meant a projection of statutory profits, with a certain level of capital locked in, usually expressed as a percentage of Solvency I statutory minimum solvency margin, i.e., effectively a traditional embedded value (TEV) approach for life business. For non-life business, equivalent discounted cash flow models are often used.

Whilst under Solvency II a number of factors may influence distributable profits, we believe that the most important drivers, particularly in the medium to long term, will be the required level of Solvency II capital[1] and the own funds available and eligible to cover it. Therefore our proposed valuation methodology focuses on these metrics. However, we note that there may be additional constraints on distribution of surplus, which are discussed later.

Our basic goal has been to develop a methodology which measures value as the net present value of future expected distributable profits at the investor's required rate of return.

We are not saying that every investor will or should want to value insurance companies in this way. But for investors who do have this perspective, we think that our proposed methodology is a good way to go about it. In Section 3 below, we set out a comparison with other valuation methodologies, in particular market-consistent embedded value (MCEV).

Of course, in theory this could be achieved by making a complete projection of the Solvency II economic balance sheet and capital requirements, including allowance for future new business.

In practice it will tend to be very challenging to get a full long-term projection of the balance sheet. Approximations likely to be available, such as business plan or Own Risk and Solvency Assessment (ORSA) projections, may introduce material distortions into any valuation approach. Examples of the types of distortions which may emerge are due to:

- Difficulty of projecting own funds if business plans are based on International Financial Reporting Standards (IFRS) or local statutory accounting.
- Simplified driver approaches to Solvency Capital Requirement (SCR) and risk margin projections.
- New business.
- Combining real-world projections up to future balance sheet dates, with risk-neutral bases for valuing liabilities.

Our methodology therefore aims to decompose the value into given components, which can be valued more easily with a reasonable level of precision based on information likely to be available as part of the Solvency II reporting process. Furthermore, this decomposition can be very useful in understanding the value attributed to certain activities of the insurance company, such as new sales and asset management.

An additional advantage of this methodology is that it can be applied equally to life, non-life, and health business, because it is derived directly from the Solvency II balance sheet, and SCR and risk margin calculations which are defined for all types of insurance.

The structure of the paper is as follows: In Section 2 we develop the theoretical methodology starting from a narrowly-defined limit case and then consider the various refinements which are necessary to generalise this. In Section 3 we compare the methodology with alternatives.

1 Companies are likely to hold more than simply SCR, based on an assessment of their own solvency needs, risk appetite, etc.

2. Development of S2AV methodology

2.1 RELATIONSHIP BETWEEN NPV (DISTRIBUTABLE PROFITS) AND SOLVENCY II AVAILABLE OWN FUNDS

Under some narrow limit conditions, Solvency II own funds will actually be equal to the net present value (NPV) of distributable profits, i.e., the Solvency II appraisal value (S2AV).

In particular this would require the following:

- An assumption that no hedgeable risks are taken (i.e., all risks which can be hedged are hedged immediately following the valuation date at the price implied by the Solvency II valuation)[2] and that this means that the projected SCR is the same as that backing the risk margin calculation.[3]
- No future new business (i.e., all business is already within the Solvency II contract boundary as at the valuation date).
- The company can maintain a solvency ratio (own funds/SCR) of exactly 100%.
- The tax rate is zero.[4]
- The shareholders' required rate of return above risk free is equal to 6% (cost of capital used in the risk margin calculation).
- Assets backing own funds and the risk margin earn risk-free rates.
- The eligibility rules reflect the economic value of the relevant own fund items.

Conceptually, this equivalence can be seen by projecting the balance sheet forward under the above conditions:

- If we consider the best estimate liabilities (BEL) and the assets backing BEL, then this will not give rise to any change in own funds because we have assumed they are matched going forward.
- Future movements in own funds will therefore only emerge through:
  - Investment returns on assets backing own funds.
  - Investment returns on assets backing the risk margin.
  - Changes in risk margin (unwind and releases).
  - Dividends and capital injections (effectively positive and negative distributable profits), arising when own funds are greater or less than SCR, respectively.

Under the conditions described above (excluding the requirement that the shareholders' required rate of return above risk-free is equal to 6%), we can show that:

$$(1)\ S2AV = NPV\ (\text{distributable profits}) = OF + RM - (COC_{SCR} + COC_{RM})$$

where:

- Distributable profits are discounted at shareholders' required rate of return (which is not necessarily equal to the risk-free rate)
- OF = own funds at time 0
- RM = risk margin at time 0
- COC_{SCR} is the cost of capital[5] (COC) associated with holding the SCR
- COC_{RM} is the cost of capital associated with holding the risk margin

This equivalence is proved in the Appendix.

2 The assumption that no hedgeable risks are taken is interpreted as implying that assets and liabilities will remain matched at future points in time, i.e., effectively that asset cash flows will replicate liability cash flows at future points in time in all scenarios.

3 Note that this might not be true in specific cases, which is due to a variety of factors (discussed later in this paper) such as the fact that the risk margin does not make allowance for the loss-absorbing capacity of deferred taxes.

4 And consequently there is no loss-absorbing capacity of deferred taxes.

5 The cost of capital associated with holding the SCR or risk margin is the value of shortfalls between the shareholders' required rate of return and the actual rate of return on the SCR or risk margin, discounted at the shareholders' required rate of return.

Further, if the shareholders' required rate of return is the risk-free rate plus 6% (the cost of capital assumed in the risk margin calculation), then:

(2) $RM = COC_{SCR} + COC_{RM}$

and hence:

(3) $S2AV = OF$

The equivalence *(2)* is proved in the Appendix.

We illustrate expression *(1)* by considering the simple example of a single premium, non-participating life policy,[6] with sum assured of 100 in 20 years' time, and initial own funds of 12. Other key assumptions are:

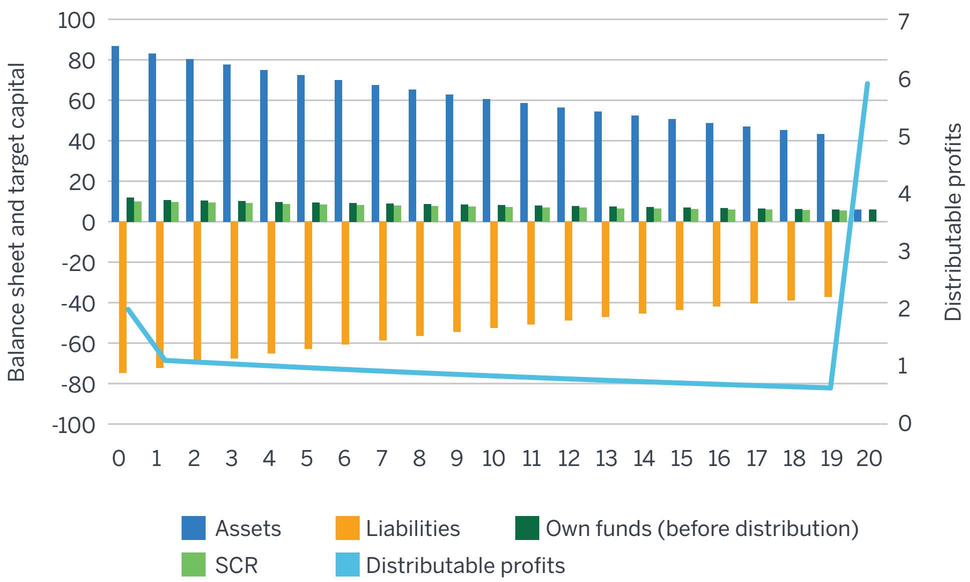
- Risk-free rate of 2%.
- Shareholders' required rate of return = risk-free + 10%.
- Lapse rate = 5% p.a., BEL paid on lapse.
- Initial SCR for non-hedgeable risks = 10. Thereafter this is assumed to move proportionally to BEL.

FIGURE 1: S2AV EXAMPLE—ILLUSTRATION OF EXPRESSION *(1)*

NPV (DISTRIBUTABLE PROFITS)	9.50
OF	12.00
RM	7.55
COC_{SCR}	6.26
COC_{RM}	3.79
$OF + RM - (COC_{SCR} + COC_{RM})$	9.50

The graph in Figure 2 then shows the distributable profits in each time period, together with key Solvency II balance sheet items and SCR.

FIGURE 2: GRAPHIC ILLUSTRATION OF DISTRIBUTABLE PROFITS BY YEAR



6 We note that it is not a requirement for the expression in *(1)* to hold that the liability portfolio under consideration be non-participating.

The table in Figure 3 shows these same results for the first 10 years.

FIGURE 3: DISTRIBUTABLE PROFITS BY YEAR, FIRST 10 YEARS

	0	1	2	3	4	5	6	7	8	9	10
ASSETS	86.8	83.1	80.3	77.6	75.0	72.4	69.9	67.5	65.2	62.9	60.7
LIABILITIES	-74.8	-72.3	-69.8	-67.5	-65.1	-62.9	-60.7	-58.6	-56.5	-54.5	-52.6
OWN FUNDS (BEFORE DISTRIBUTION)	12.0	10.8	10.5	10.1	9.8	9.5	9.2	8.9	8.7	8.4	8.1
SCR	10.0	9.7	9.4	9.1	8.8	8.5	8.3	8.0	7.8	7.5	7.3
DISTRIBUTABLE PROFITS	**2.0**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**

The table in Figure 4 shows the projected distributable profits for the first 10 years built up in the same way as that set out in the Appendix proof of expression *(1)*.

FIGURE 4: DISTRIBUTABLE PROFITS BY YEAR, PER EXPRESSION *(1)*

	0	1	2	3	4	5	6	7	8	9	10
INTEREST ON OWN FUNDS		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INTEREST ON RISK MARGIN		0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
RELEASE OF SCR		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
RELEASE OF RISK MARGIN		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
INITIAL OWN FUNDS - SCR	2.0										
DISTRIBUTABLE PROFITS	**2.0**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**

As we have shown above, subject to certain conditions, the net present value of distributable profits can be shown to be equal to the own funds. However, in real cases one or more of these conditions may not hold and therefore we need to generalise the methodology to take account of variations in these conditions. We have been able to develop a methodology which allows most of these conditions to vary whilst still maintaining the equivalence with the present value of real-world distributable profits. This is done by making a series of adjustments to initial own funds (OF) to achieve a value, the Solvency II appraisal value (S2AV), which—as stated above—is equal to the present value of real-world expected distributable profits at the shareholders' required rate of return.

2.2 IMPACT OF TAX

Tax is a potentially complex issue under Solvency II, given that the taxable basis is unlikely to be the Solvency II basis, but will probably be based on some version of statutory profits. However, we believe that if the Solvency II balance sheet includes deferred tax liabilities (DTL) / deferred tax assets (DTA), which allow appropriately for the differences in tax basis compared with Solvency II, there should be no impact on results other than timing.

For the purpose of this paper we have, however, assumed that the taxable basis is actually the Solvency II basis, in order to avoid complications of the impact of DTL/DTA effects in the presentation of our methodology.

With tax, the expression *(3)* above, *S2AV = OF*, no longer holds.

We therefore return to expression *(1)*. With tax rate *tax%*, this generalises to:

$$(4)\ S2AV = NPV\ (distributable\ profits) = OF + RM * (1 - tax) - (COC_{SCR} + COC_{RM})$$

This equivalence is proved in the Appendix. Please note that the formula definitions of COC_{SCR} and COC_{RM} now include appropriate allowance for tax, and therefore differ from those underlying expressions *(1)* to *(3)* above.

2.3 REQUIRED RATE OF RETURN AND EXPECTED CAPITALISATION

It will often be the case that the shareholders' required rate of return is different from 6% above risk-free (the cost of capital assumption used to calculate the Solvency II risk margin). This has already been allowed for in expression *(4)* above.

Furthermore, it will not typically be possible to manage an insurance company with a solvency ratio of exactly 100% of SCR. Some increase in the level of capital is likely to be required.

On the other hand, it may be noted that the risk margin calculation is not permitted to make allowance for the loss-absorbing capacity of deferred taxes, something which shareholders may feel in practice they will be able to get credit for in the SCR they actually have to hold. However, we have already separated out the link between risk margin and SCR in expression *(4)*, so this can be adjusted for straightforwardly.

We need to separately recalculate COC_{SCR} and COC_{RM}, allowing for the new target solvency ratio *(TSR)*, the loss-absorbing capacity of deferred taxes if appropriate, and the shareholders' required rate of return.

If we assume:

- A new *TSR*
- Shareholders' required rate of return = risk discount rate = *RDR*
- SCR is projected to allow for deferred taxes as appropriate

then:

$$(5)\ S2AV = NPV\ (distributable\ profits)@RDR = OF + RM * (1 - tax) - TSR * COC_{SCR} - COC_{RM}$$

This equivalence is proved in the Appendix.

We note that a projection of SCRs for non-hedgeable risks should be able to be derived from the risk margin calculation, from which a projection of the risk margin itself can also be derived. Thus the last two terms can be calculated to the same degree of precision as the risk margin.

If we update our example from Section 2.1 above so that:

- *TSR* = 150%
- *Tax rate* = 20%

We get an illustration of expression *(5)* in the table in Figure 5.

FIGURE 5: ILLUSTRATION OF EXPRESSION *(5)*

NPV (DISTRIBUTABLE PROFITS)	5.24
OF	12.00
RM	7.55
COC_{SCR}	6.51
COC_{RM}	3.03
tax	20%
TSR	150%
$OF + RM * (1\text{-}tax) - TSR * COC_{SCR} - COC_{RM}$	5.24

Distributable profits by year are shown in the following graph and tables in Figures 6, 7, and 8.

FIGURE 6: GRAPHIC ILLUSTRATION OF DISTRIBUTABLE PROFITS BY YEAR

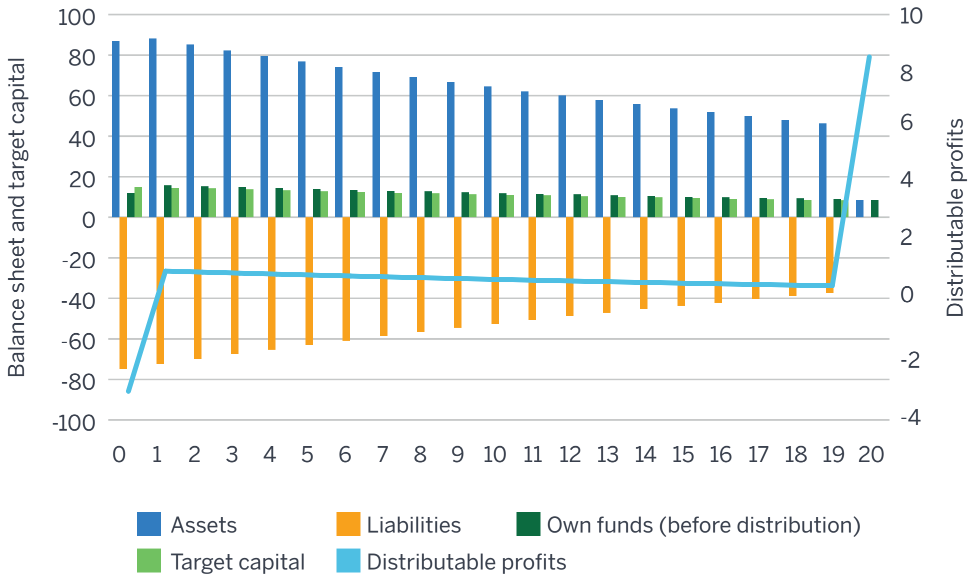


FIGURE 7: DISTRIBUTABLE PROFITS BY YEAR

	0	1	2	3	4	5	6	7	8	9	10
ASSETS	86.8	88.0	85.1	82.2	79.4	76.7	74.1	71.6	69.1	66.7	64.4
LIABILITIES	-74.8	-72.3	-69.8	-67.5	-65.1	-62.9	-60.7	-58.6	-56.5	-54.5	-52.6
OWN FUNDS (BEFORE DISTRIBUTION)	12.0	15.7	15.2	14.8	14.3	13.9	13.4	13.0	12.6	12.2	11.8
TARGET CAPITAL	15.0	14.5	14.1	13.6	13.2	12.8	12.4	12.0	11.7	11.3	10.9
DISTRIBUTABLE PROFITS	**-3.0**	**1.2**	**1.1**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**

FIGURE 8: DISTRIBUTABLE PROFITS BY YEAR BROKEN DOWN BY COMPONENT

	0	1	2	3	4	5	6	7	8	9	10
INTEREST ON OWN FUNDS, NET OF TAX		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INTEREST ON RISK MARGIN, NET OF TAX		0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
RELEASE OF TARGET CAPITAL		0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
RELEASE OF RISK MARGIN, NET OF TAX[8]		0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
INITIAL OWN FUNDS - TARGET CAPITAL	-3.0										
DISTRIBUTABLE PROFITS	**-3.0**	**1.2**	**1.1**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**

7 In our example we have assumed that the tax basis is the same as the Solvency II basis, so that movements in risk margin are netted down for tax. Even if this is not the case, movements in risk margin would be reflected in movements in DTL/DTA.

2.4 HEDGEABLE RISKS

The fact that risks are hedgeable implies it is theoretically possible to hedge them and hence that the company is not obliged to take such risks. Therefore we should normally assume that such risks are taken because they are expected to be more than compensated by increased investment or other returns.

In particular, in the case of non-participating business (e.g., non-life business and pure risk business), it would indeed be illogical to take investment risks without an expectation that the increased return would more than compensate the cost of holding the resulting increased capital. For participating life business there are likely to be other considerations, discussed below.

A decision to take hedgeable risks will depend on the investor's risk appetite and own assessment of risks and required returns.

If we make a simplifying assumption that the expected uplift in asset return and asset risk (i.e., capital to be held) are constant over time as a proportion of risky assets[8] then we can express the impact on *NPV (distributable profits)* as:

*NPV (Total risky assets at all points in time)@RDR * (Net of tax return in excess of risk free - Capital charge for risky assets)* [9]

If excess returns on risky assets above risk-free *i* are equal to a constant margin *m*, and the additional capital required for risky assets is a constant proportion *p* of risky assets, then the impact on *NPV (distributable profits)*, *R*, can be expressed as:

(6) R = NPV(risky assets)@RDR * {m*(1-tax)-(RDR-i*(1-tax))*p*TSR}

The derivation of this is shown in the Appendix.

Note that, by allowing for value to be generated (or destroyed) through holding of risky assets, we have made an important departure from market-consistent methodology. A market-consistent methodology can be viewed as implicitly assuming that any additional return expected on assets is cancelled by the additional risk (because the market price represents the market view of risk). By contrast, the proposed S2AV methodology reflects the investor's own view of the expected additional return and the risk is reflected through the risk capital which needs to be held and the shareholders' required rate of return. The approach adopted should depend on both the purpose and the perspective of the person using the numbers. In some cases, the proposed methodology may not be appropriate, and a market-consistent approach could be more applicable.

In practice, of course, the expected excess return and additional capital as a proportion of risky assets may not be constant over time. If we consider equities, this assumption may be reasonable because the equity capital charge and presumably the expected equity risk premium will be a constant proportion of the equities held. If, however, we consider spread risk, then the capital charge will depend on the duration of the spread assets, which will presumably shorten over time (particularly as we are assuming no future new business at this stage).

The assumption of constant uplift in asset return and additional capital over time is only made to make the algebra simpler. Computationally, it would not be much more difficult to calculate S2AV for a case where these items varied over time.

8 Investment in risky assets should consider the impact on the cost of options and guarantees. Consideration should be given to the impact of stochastic variations on a real-world basis going forward (perhaps by considering a small number of stochastic scenarios), but it would be expected that this would be carried out on a simplified basis.

9 *NPV (Total risky assets at all points in time)* is calculated by discounting the amount of the risky assets as at the start of each future time period. This would typically be yearly, in which case the *net of tax return in excess of risk free* and the *capital charge for risky assets* would be per annum.

We note that the additional capital can also be impacted by:

- Diversification benefit with capital arising from hedgeable risks.
- Loss-absorbing capacity of deferred taxes.

This may also mean that the additional capital does not remain a constant proportion of risky assets over time, but in some cases this will be a reasonable approximation. Of course, it is also possible to estimate the additional capital as a proportion of risky assets over time with varying degrees of sophistication.

If we now update our example from Section 2.3 above with the following additional assumptions:

- 50% of assets are risky
- Spread earned on risky assets = 4%
- Stress factor for risky assets = 30% of risky assets
- Initial own funds increased to 35

Then the total value of S2AV builds up as shown in the table in Figure 9.

FIGURE 9: ILLUSTRATION OF EXPRESSION (6)

NPV (DISTRIBUTABLE PROFITS)	28.37
OF	35.00
RM	7.55
COC_{SCR}	6.51
COC_{RM}	3.03
tax	20%
TSR	150%
m	4%
p	30%
*p' = p * AVERAGE DIVERSIFICATION FACTOR WITH CAPITAL ARISING FROM HEDGEABLE RISKS*	20%
NPV (RISKY ASSETS)	325.94
$OF + RM * (1\text{-}tax) - TSR * COC_{SCR} - COC_{RM} + NPV(RISKY\ ASSETS)@RDR * \{m*(1\text{-}tax)\text{-}(RDR\text{-}i*(1\text{-}tax))*p'*TSR\}$	28.37

Distributable profits by year are shown in the following graph and tables in Figures 10, 11, and 12.

FIGURE 10: GRAPHIC ILLUSTRATION OF DISTRIBUTABLE PROFITS BY YEAR

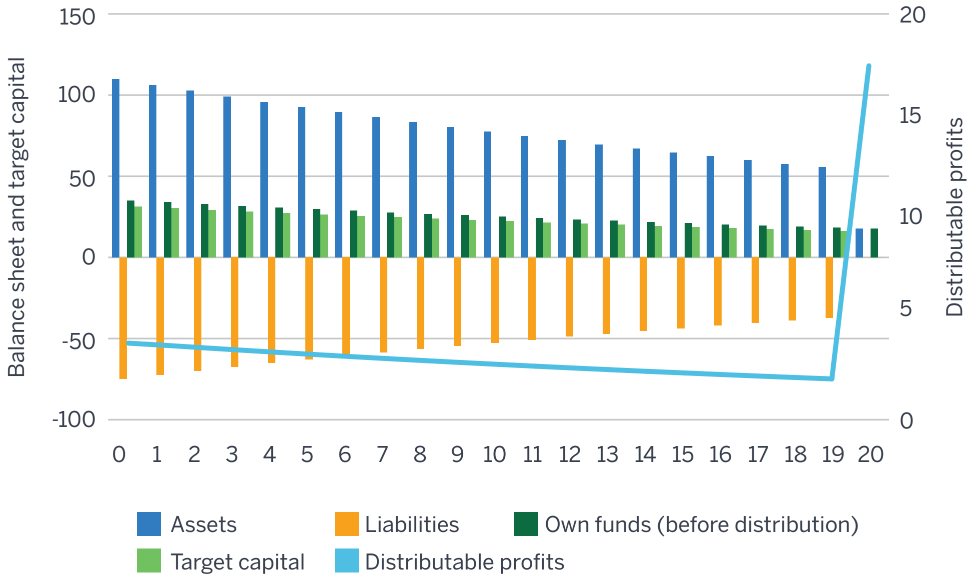


FIGURE 11: DISTRIBUTABLE PROFITS BY YEAR

	0	1	2	3	4	5	6	7	8	9	10
ASSETS	109.8	106.2	102.6	99.1	95.8	92.5	89.4	86.3	83.3	80.4	77.6
LIABILITIES	-74.8	-72.3	-69.8	-67.5	-65.1	-62.9	-60.7	-58.6	-56.5	-54.5	-52.6
OWN FUNDS (BEFORE DISTRIBUTION)	35.0	33.9	32.8	31.7	30.6	29.6	28.7	27.7	26.8	25.9	25.0
TARGET CAPITAL	31.2	30.2	29.2	28.2	27.3	26.4	25.5	24.7	23.8	23.0	22.3
DISTRIBUTABLE PROFITS	**3.8**	**3.7**	**3.6**	**3.5**	**3.4**	**3.2**	**3.1**	**3.0**	**2.9**	**2.8**	**2.7**

FIGURE 12: DISTRIBUTABLE PROFITS BY YEAR BROKEN DOWN BY COMPONENT

	0	1	2	3	4	5	6	7	8	9	10
INTEREST ON OWN FUNDS, NET OF TAX		0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
INTEREST ON RISK MARGIN, NET OF TAX		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ADDITIONAL RETURNS ON RISKY ASSETS, NET OF TAX		1.7	1.6	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.2
RELEASE OF TARGET CAPITAL		1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.8	0.8	0.8
RELEASE OF RISK MARGIN, NET OF TAX		0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
INITIAL OWN FUNDS - TARGET CAPITAL	3.8										
DISTRIBUTABLE PROFITS	**3.8**	**3.7**	**3.6**	**3.5**	**3.4**	**3.2**	**3.1**	**3.0**	**2.9**	**2.8**	**2.7**

PARTICIPATING LIFE BUSINESS

In the case of participating life business, we need to additionally make allowance for the following:

- The fact that part of the additional return on assets may be passed to policyholders in the form of profit participation.
- The impact of loss-absorbing capacity of technical provisions on required capital.
- The impact of Financial Options and Guarantees (FOGs).
- Potentially less clarity over which risks are hedgeable. For instance, dynamic policyholder behaviour can make interest rate guarantees difficult to hedge.

At the simplest level we might generalise the impact of investing in risky assets on S2AV, *R*, to be given by the expression:

*(7) R= NPV(risky assets)@RDR * {m*s*(1-tax)-(RDR-i*(1-tax))*p*(1-L)*TSR}*

where:

- *s* = shareholders' proportion of additional returns
- *L* = loss-absorbing capacity of technical provisions in respect of the additional capital required for risky assets (as a percentage)

Again it should be noted that:

- The shareholders' proportion of additional returns may not, in practice, remain constant over the projection period. For example, in some cases older business may have higher interest rate guarantees and hence this business may run off more quickly, causing average guarantee rates to reduce over time.
- The loss-absorbing capacity of technical provisions may not be constant over the projection period for similar reasons.

Further updating our example with the following assumptions:

- Participating policy with: Policyholder return = max(earned rate * profit-sharing % , minimum guaranteed rate)
- Profit-sharing % = 80%
- Minimum guaranteed rate = 1%

We then get an illustration of expression *(7)* as shown in the table in Figure 13.

FIGURE 13: ILLUSTRATION OF EXPRESSION (7)

NPV (DISTRIBUTABLE PROFITS)	23.95
OF	35.00
RM	8.56
COC_{SCR}	7.08
COC_{RM}	3.58
tax	20%
TSR	150%
m	4%
p	30%
*p' = p * AVERAGE DIVERSIFICATION FACTOR WITH CAPITAL ARISING FROM HEDGEABLE RISKS*	19%
s (AVERAGE OVER PROJECTION)	42%
L (AVERAGE OVER PROJECTION)	28%
NPV (RISKY ASSETS)	433.91
*OF + RM * (1-tax) – TSR * COC_{SCR} - COC_{RM} + NPV(RISKY ASSETS)@RDR * {m*s* (1-tax)-(RDR-i* (1-tax))*p' * (1-L) *TSR}*	23.95

Distributable profits by year are shown in the graph and tables in Figures 14, 15, and 16.

FIGURE 14: GRAPHIC ILLUSTRATION OF DISTRIBUTABLE PROFITS BY YEAR

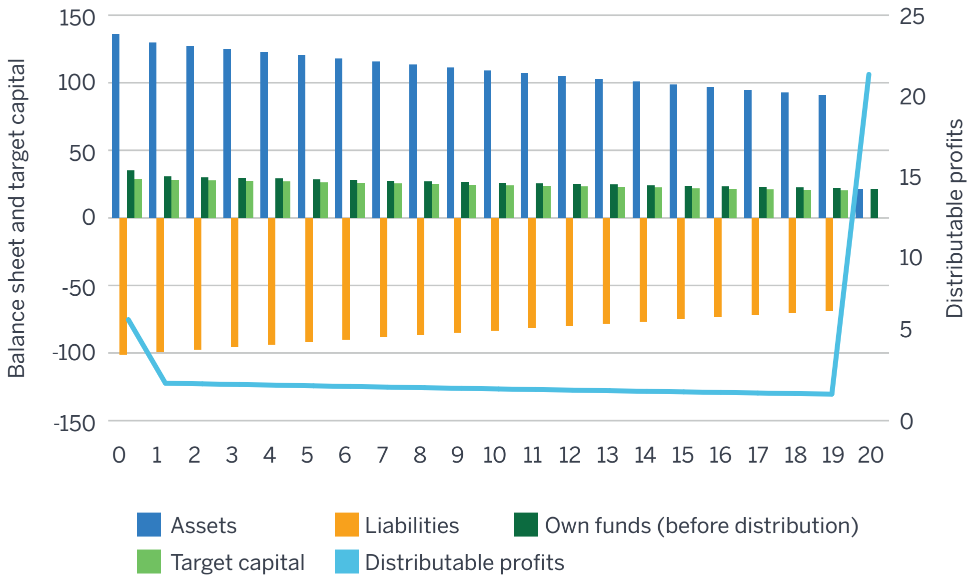


FIGURE 15: DISTRIBUTABLE PROFITS BY YEAR

	0	1	2	3	4	5	6	7	8	9	10
ASSETS	136.0	129.7	127.3	124.9	122.6	120.3	118.0	115.7	113.5	111.3	109.2
LIABILITIES	-101.0	-99.1	-97.3	-95.4	-93.6	-91.8	-90.0	-88.3	-86.6	-84.9	-83.2
OWN FUNDS (BEFORE DISTRIBUTION)	35.0	30.6	30.0	29.5	29.0	28.5	27.9	27.5	27.0	26.5	26.0
TARGET CAPITAL	28.7	28.2	27.7	27.2	26.8	26.3	25.8	25.4	24.9	24.5	24.0
DISTRIBUTABLE PROFITS	**6.3**	**2.3**	**2.3**	**2.2**	**2.2**	**2.2**	**2.1**	**2.1**	**2.0**	**2.0**	**2.0**

FIGURE 16: DISTRIBUTABLE PROFITS BY YEAR BROKEN DOWN BY COMPONENT

	0	1	2	3	4	5	6	7	8	9	10
INTEREST ON OWN FUNDS, NET OF TAX		0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
INTEREST ON RISK MARGIN, NET OF TAX		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ADDITIONAL RETURNS ON RISKY ASSETS, NET OF TAX		2.1	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.7
PART OF ADDITIONAL RETURNS PASSED TO POLICYHOLDER		-1.2	-1.2	-1.2	-1.1	-1.1	-1.1	-1.1	-1.1	-1.0	-1.0
RELEASE OF TARGET CAPITAL		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4
RELEASE OF RISK MARGIN, NET OF TAX		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
INITIAL OWN FUNDS - TARGET CAPITAL	6.3										
DISTRIBUTABLE PROFITS	**6.3**	**2.3**	**2.3**	**2.2**	**2.2**	**2.2**	**2.1**	**2.1**	**2.0**	**2.0**	**2.0**

Under the conditions of our example we note that there may be a trade-off between the proportion of any additional return that is due to the shareholders *(s)* and the percentage impact of loss-absorbing capacity of technical provisions *(L)*.

The table in Figure 17 shows the possible situation at different levels of in-the-moneyness of the guarantees, all other things being equal.

FIGURE 17: SITUATIONS AT DIFFERENT LEVELS OF IN-THE-MONEYNESS OF GUARANTEES

IN-THE-MONEYNESS OF GUARANTEES	POTENTIAL FOR SHAREHOLDERS BENEFITING FROM ADDITIONAL RETURN ON RISKY ASSETS BACKING PAR BUSINESS	POTENTIAL FOR LOSS ABSORBING CAPACITY OF TECHNICAL PROVISIONS IN RESPECT OF MARKET SHOCK
DEEPLY IN THE MONEY	HIGH	LOW
AT THE MONEY	REDUCED	LOW
WELL OUT OF THE MONEY	REDUCED	HIGH

Under the conditions of our example, a situation in which guarantees are at the money offers the least possibility for the shareholders of benefiting from investing in risky assets. This is illustrated and developed in Section 2.5 below.

We should remember that there are other reasons to hold a certain mix of assets, for example in order to meet policyholders' reasonable expectations, or in order to sell profitable new business. In the latter case, holding risky assets may result in higher sales, which may act to offset any decrease in profitability.

2.5 EXAMPLE

In order to illustrate and explore some of the issues highlighted in Section 2.4 above, we return to our simple example.

To recap:

This is based on a single premium policy, with sum assured of 100 in 20 years' time. We now set initial own funds to 50. Where profit participation is included, it is added to the sum assured.

The main assumptions are as follows:

- Risk-free rate of 2%
- Shareholders' required rate of return = risk-free + 10%
- Target capital = 150% of SCR
- Spread earned on risky assets = 4%
- Stress factor for risky assets = 30% of risky assets
- Policyholder return = max(earned rate * profit-sharing % , minimum guaranteed rate)
- Lapse rate = 5% p.a.
- BEL paid on lapse
- Tax rate = 20%

For calculation of SCR:

- Initial SCR for non-hedgeable risks = 10. Thereafter it moves proportionally to BEL.
- All non-hedgeable risks are assumed to be included in the risk margin.
- Impact of market stress on future yields spread over 10 years (i.e., we assume that the market stress of 30% of risky assets backing BEL produces a level reduction in earned rates over 10 years, such that the impact of this reduction in earned rates discounts back to the reduction in asset value resulting from the stress).
- Loss-absorbing capacity of technical provisions in respect of the additional capital required for risky assets (as a percentage) calculated at the start, then assumed to remain a constant percentage over the projection period.
- Loss-absorbing capacity of deferred taxes ignored.

The impact of Time Value of Financial Options and Guarantees (TVFOG) has been excluded.

The expressions *(5)* and *(7)* above still hold, with *(7)* refined so that *p* allows for the average diversification benefit between SCR_{mkt} and SCR for non-hedgeable risks.

The graphs in Figures 18 and 19 illustrate how:

- *s* (shareholders' proportion of additional returns)
- *L* (loss-absorbing capacity of technical provisions in respect of the additional capital required for risky assets as a percentage)
- *R* (impact of investing in risky assets on S2AV)

all vary with the minimum guarantee rate and profit-sharing percentage (assuming 50% invested in risky assets).

FIGURE 18: VARIATION BY PROFIT-SHARING PERCENTAGE

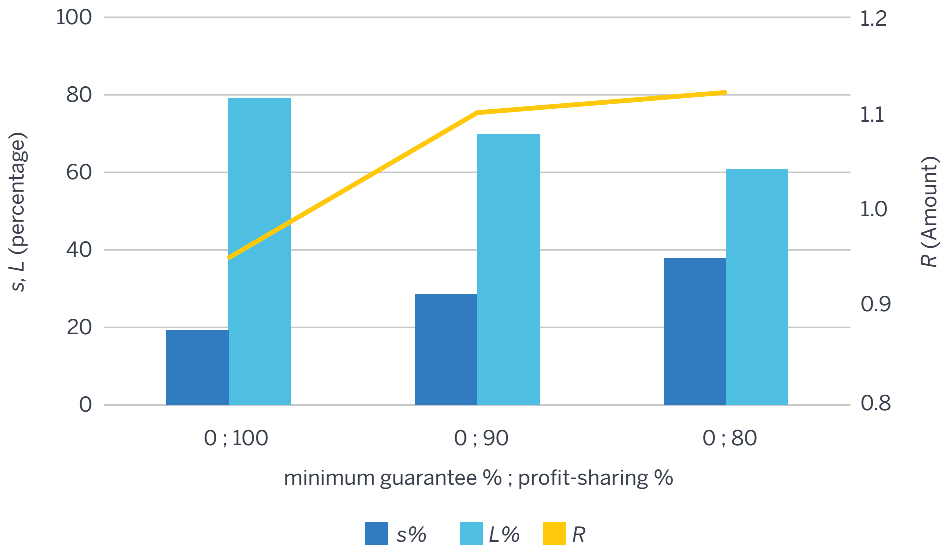


FIGURE 19: VARIATION BY MINIMUM GUARANTEE PERCENTAGE

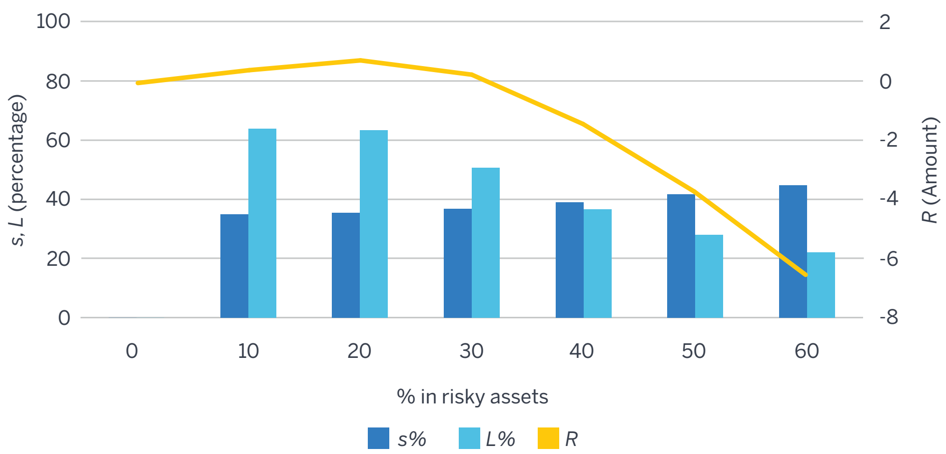
As can be seen, the impact of investing in risky assets on S2AV *(R)* rises slightly as the profit-sharing percentage to policyholders decreases from 100% to 80%, mainly as a result of the shareholders' proportion of additional return *(s)* increasing and the percentage of loss-absorbing capacity of technical provisions in respect of the additional capital required for risky assets *(L)* decreasing.

Fixing the policyholder profit-sharing percentage at 80%, the shareholders' proportion of additional returns increases, but the loss-absorbing capacity of technical provisions decreases with increasing guarantee rate. The loss-absorbing capacity of technical provisions becomes zero at the point where guarantees are at the money (i.e., where the guarantee rate equals the risk-free rate, so that no part of the reduction in returns arising from the market stress can be passed to the policyholder). The shareholders' proportion of additional returns reaches 100% at a guarantee rate of 4% (because the return, including the additional return on risky assets, equals 4%, so that all the additional return goes to the shareholders to pay for the cost of the guarantee).

Thus, overall, the impact of investing in risky assets decreases as the guarantee rate increases from 0% (guarantees well out of the money), to 2% (guarantees at the money), and then begins to increase again as guarantees move into the money (there is a slight fall from 3% to 4%, which is due to second-order effects).

If we now fix the minimum guarantee at 1%, the profit-sharing rate at 80%, and vary the percentage invested in risky assets, we see the pattern shown in the graph in Figure 20.

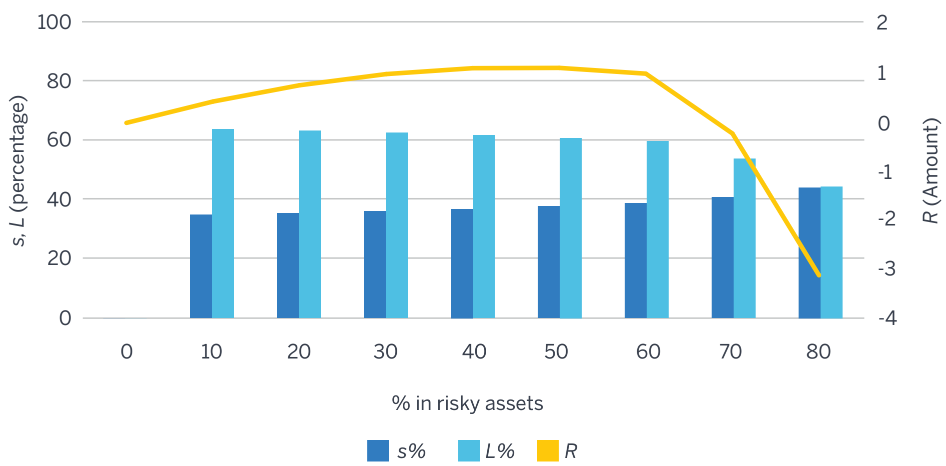
FIGURE 20: VARIATION BY PERCENTAGE IN RISKY ASSETS (1% GUARANTEE)



As the percentage invested in risky assets increases, the shareholders' proportion of additional returns rises gently, whereas the loss-absorbing capacity of technical provisions decreases (as the SCR_{mkt} stress causes a greater reduction in projected investment returns, which begins to limit the ability to pass on these losses to policyholders as, post-stress, guarantees come into the money). Furthermore, as the size of SCR_{mkt} increases, the diversification benefit with the SCR for non-hedgeable risks decreases.

For a 0% guarantee rate we get the pattern shown in the graph in Figure 21.

FIGURE 21: VARIATION BY PERCENTAGE IN RISKY ASSETS (0% GUARANTEE)



With these assumptions, the maximum value is achieved at around 50% in risky assets. In particular, as the guarantees are further out of the money pre-stress (compared with the 1% guarantee case above), the reduction in loss-absorbing capacity as the percentage in risky assets increases is much more gradual than with a 1% guarantee, and only reduces significantly as the mix gets to around 70%. The gradual increase in shareholders' proportion of additional returns, and the decrease in diversification benefit, follow similar patterns for the case with a 1% guarantee.

These results illustrate how the additional benefit from investing in risky assets varies with the level of the in-the-moneyness of guarantees, and the percentage of investment return passed to the shareholder, because they impact the level of additional return on risky assets taken by the shareholders, the loss-absorbing capacity of technical provisions, and the level of diversification benefit between SCR_{mkt} and SCR for non-hedgeable risks.

We note that the results in this section are only illustrations of the types of effects which may be considered, and are not intended necessarily to represent realistic results.

2.6 NEW BUSINESS

Under some circumstances it might be desirable and possible to project in full all future years' new business, but this will often prove to be impracticable. A common shortcut in appraisal value methodology is to consider the impact of one year's new business, and then apply a multiplier to capture the effect of the subsequent years.

The value of one year's new business can be calculated in a similar way to the expressions above.

For instance, if we take the conditions underlying expression *(5)* above, and consider new business on a stand-alone basis, we can define Solvency II new business value *(S2NBV)* as:

$$(8)\ OF(0) + RM(0) * (1 - tax) - COC_{RM}(0) - TSR * COC_{SCR}(0)$$

Where $OF(0)$ = own funds generated at point of sale, after appropriate taxes, before any distribution (or capital injection) at time 0. $COC_{RM}(0)$ *and* $COC_{SCR}(0)$ are also applicable at point of sale.

This equivalence is proved in the Appendix.

In addition, adjustments along the lines of those set out in Section 2.4 above in respect of taking on hedgeable risks can also be made.

The stand-alone value should be adjusted in respect of interactions with the in-force value, including, for example:

- Diversification benefits in respect of capital requirements.
- Marginal effects of pooling in-force and new business where investments are pooled together, e.g., effect on asset liability management (ALM) position for participating business.
- Tax interactions.

Determining a suitable multiplier to apply to one year's new business value is a common problem to all embedded value (EV) methodologies. In particular, this should take into account the fact that the value of each year's new business can change over future years because of:

- Moving along the yield curve as we project forward.
- Changing mix and profitability of new business.
- Changing relative volumes of in-force and new business with their different risk profiles.

2.7 CAVEATS TO THE PROPOSED METHODOLOGY

A potentially important caveat to the proposed methodology is that there may be other constraints on profits being distributable in addition to those prescribed by Solvency II requirements. They are likely to be defined by local regulations and will vary by country.

Constraints based on statutory profits may be applied in some countries, for instance making it difficult to distribute more than the accumulated statutory profits, or other limits on dividend payment. However, over time we would expect a trend towards constraints based wholly on Solvency II considerations.

There may also be local asset coverage requirements, applying separately to those required by Solvency II. They might include the requirement to cover participating business with assets measured at book value, or not to allow holding fewer assets to back unit-linked business than the amount of the unit value. But this is an issue which would also apply to an EV type of valuation based on local statutory profits.

Note that there may be ways around such restrictions post-transaction, such as reinsurance.

Nonetheless, such constraints could be tested for, and an adjustment made, perhaps through assuming a higher target solvency ratio or other on-top adjustments. This could tie in with the company's assessment of own risk and overall solvency needs, including the forward-looking perspective under ORSA.

Other factors which may need to be considered in the valuation, relating to the application of Solvency II, could include:

- Eligibility of capital/tiering.
- Ring-fenced funds.
- Group requirements.
- Transitional measures.

In addition, there are further issues, not particular to Solvency II, which might include:

- Non-liquid assets, such as strategic investments or own property.
- Other shareholders/joint ventures.

These two points, however, would also be issues under an EV type of valuation based on statutory profits.

Nonetheless, in most cases we believe the Solvency II solvency position will be the overriding driver of distributable profits in the mid to long term. We believe it will therefore usually be more meaningful to base the valuation on Solvency II metrics and possibly adjust the target solvency ratio, or make other on-top adjustments to allow for other factors, than to use some definition of distributable profits based on statutory earnings. We would also point out that other valuation methodologies may need to deal with many of the issues above.

We note further that, in an M&A context, there may be some synergies to factor in, such as diversification with an existing insurance company, for the calculation of SCR, etc. However, the focus of this paper is the valuation of a stand-alone insurance company, and we do not comment on this further here.

A further objection may be to the use of "real-world" projections. However, we note that this methodology is aimed at those who have a "real-world" view (such as investors). Taking a view here as to whether this is appropriate, or what, for instance, should be an investor's required return on capital, is beyond the scope of this paper. In addition, the forward-looking perspective of the overall solvency needs assessment under ORSA adopts a similar approach in this respect, in that projections are made of future Solvency II balance sheets and capital requirements under a real-world view.

We have not dealt with the issue of TVFOG in this paper. In our initial premise in Section 2.2 above, we assume that all risks are hedged, including Financial Options and Guarantees (FOGs), and we don't think there is any particular complication here.

The introduction of "real-world" returns will have an impact on the TVFOG at each future balance sheet date. In our experience, companies make projections of TVFOG in a fairly simple way. More sophisticated approaches assuming real-world returns followed by stochastic, risk-neutral scenarios are possible, although quite challenging technically.

3. Comparison with other valuation methods

Our proposed methodology can be seen as similar to TEV methodology, in that it is the net present value of real-world projected distributable profits, with the discount rate representing the shareholders' required rate of return. However, there are some significant differences from a typical TEV approach:

- Statutory accounting is replaced by Solvency II accounting (e.g., statutory reserves replaced with Solvency II technical provisions).
- Required capital to be held is based on Solvency II SCR rather than on Solvency I statutory minimum solvency margin.

(As an aside we note here that EV calculations which assume that required capital is equal to Solvency II SCR, whilst on the other hand assuming that statutory reserves are held, can result in a distorted view.)

As noted above, our method follows similar projection principles to those which may be used in the forward-looking perspective of the overall solvency needs assessment under ORSA, but ORSA is not a valuation standard in itself and does not deal with issues like cost of capital. However, projections made for the forward-looking perspective under ORSA extended out for a suitable number of years could be used as the basis for an S2AV calculation.

If we consider a comparison with MCEV methodology, there are some important differences:

- MCEV and indeed the Solvency II balance sheet do not really represent forward-looking projections. Rather they are intended to represent "market-consistent" calculations; projections of cash flows (which are then discounted) are only made because this is the only practical way of placing a "market value" on most insurance liabilities (if a deep, liquid market existed for insurance liabilities, or it was possible to replicate them reliably, this would not be necessary).

  In our S2AV methodology, however, we do make a forward-looking projection (effectively of a "market-consistent" balance sheet and required capital at each future time period).
- By allowing for the shareholders' view of expected real-world investment returns and the cost of holding capital for market risks, S2AV departs from market consistency. In our experience, however, it reflects more closely the decision-making framework on which insurance companies are run and on which decisions to buy insurance companies are made.
- MCEV methodology only applies to "covered business," whereas Solvency II and S2AV cover all types of insurance. (The Group MCEV includes non-covered business, but valued on some other basis.) This also has knock-on effects in terms of not allowing for diversification with non-covered business in the calculation of the cost of residual non-hedgeable risks (CRNHR), etc.
- MCEV charges a "frictional cost" for required capital, whereas Solvency II does not require any capital charge for hedgeable risks (i.e., those not covered by the risk margin). Our S2AV method, however, does allow for a cost of capital for hedgeable risks (to the extent that they are not hedged, e.g., by investing in risky assets), and for non-hedgeable risks (to the extent that the cost of capital exceeds the 6% inherent in the risk margin calculation).
- MCEV is not a statutory standard and so will not generally be subject to the same external scrutiny as Solvency II (in particular from regulators).

There are various other particular differences between Solvency II and MCEV, which can include the following:

- Solvency II contract boundaries, which mean that MCEV does not always provide a good measure of distributable profits (if they are defined in terms of own funds and required capital under Solvency II). For instance, a highly profitable block of long-term risk business which was counted as in-force under MCEV, but was considered to have a short contract boundary under Solvency II, would be attributed a high value under MCEV (because of low, "risk-free" discount rates), despite the fact that distributable profits may take a long term to emerge (which would be reflected under S2AV). Whilst MCEV may take a more "economic" view in this sense, for many investors the amounts and timings of distributable profits are what is key, as we have noted before.
- Definitions of "risk-free" rates. Under Solvency II, reference rates may include elements such as volatility adjustment (VA) or matching adjustment (MA), together with long-term convergence to the ultimate forward rate (UFR). MCEV may use different risk-free rates, but again, we are assuming that it is the Solvency II view which drives distributable profits.
- Prescribed cost of capital for the calculation of risk margin under Solvency II, compared with the non-prescribed cost of capital in the calculation of CRNHR under MCEV reporting.

However, we note that the MCEV Principles[10] published in May 2016, do now explicitly say that companies can bring their Solvency II and MCEV methodologies and assumptions in line in some key areas, including the first two points above. The third point noted above is not specifically mentioned in this regard, but alignment in areas not specifically mentioned by the MCEV Principles is permitted as long as the nature of such alignment is disclosed.

Nonetheless, a real-world S2AV type of methodology would not be permitted under the MCEV Principles.

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Appendix: Proof of various expressions above

EXPRESSION (1)

Assume:

- Investment return rate (risk-free rate) earned on all assets = i
- Discount rate for discounting distributable profits (shareholders' required rate of return) = RDR

$OF'(t)$, $SCR(t)$, and $RM(t)$ denote the own funds (after distribution at time t), SCR, and risk margin respectively, at time t years. $OF(0)$ represents the own funds before distribution at time 0. $COC_{RM}(0)$ and $COC_{SCR}(0)$ are the cost of capital associated with holding the risk margin and SCR, respectively, at time t=0.

Assume that the business has completely run off at time $t = n$ years.

Given the conditions described, for $t > 0$, distributable profit at time t =

- Interest on $OF'(t\text{-}1)$ (rate i)
- + Interest on $RM(t\text{-}1)$ (rate i)
- + Release of SCR at time t
- + Release of risk margin at time t

$$= OF'(t-1) * i + RM(t-1) * i - (SCR(t)-SCR(t-1)) - (RM(t)-RM(t-1))$$

$$= SCR(t-1)*(1+i) - SCR(t) + RM(t-1)*(1+i) - RM(t)$$

(because $SCR(t-1) = OF'(t-1)$)

In addition, at time 0 there will be an additional distributable profit of $OF(0) - SCR(0)$.

Therefore *NPV (distributable profits)*

$$= OF(0) - SCR(0) + \sum_{t=1}^{n} \frac{RM(t-1)*(1+i)-RM(t)}{(1+RDR)^t} + \sum_{t=1}^{n} \frac{SCR(t-1)*(1+i)-SCR(t)}{(1+RDR)^t}$$

$$=OF(0) - SCR(0) + [RM(0)+SCR(0)] * (1+i)/(1+RDR) + \sum_{t=1}^{n-1}[RM(t) + SCR(t)] * \left(-\frac{1}{(1+RDR)^t} + \frac{1+i}{(1+RDR)^{t+1}}\right)$$

$$=OF(0) - SCR(0) + [RM(0)+SCR(0)] + (i\text{-}RDR) * \sum_{t=0}^{n-1} \left(\frac{RM(t)+SCR(t)}{(1+RDR)^{t+1}}\right)$$

$$= OF(0) + RM(0) - COC_{RM}(0) - COC_{SCR}(0)$$

EXPRESSION (2)

We now assume $RDR = i\% + 6\%$

$$\text{Write } COC_{TOT}(0) = COC_{SCR}(0) + COC_{RM}(0) = -(i\text{-}RDR) * \sum_{t=0}^{n\text{-}1} \left(\frac{SCR(t)+RM(t)}{(1+RDR)^{t+1}}\right) = 6\% * \sum_{t=0}^{n\text{-}1} \left(\frac{SCR(t)+RM(t)}{(1+i+6\%)^{t+1}}\right)$$

$$RM(0) = \sum_{t=0}^{n-1} \left(\frac{SCR(t)*6\%}{(1+i)^{t+1}}\right)$$

$$RM(t) = \sum_{s=t}^{n-1} \left(\frac{SCR(s)*6\%}{(1+i)^{s+1-t}}\right)$$

We can write:

$$COC_{TOT}(0) = 6\% * \sum_{t=0}^{n-1}\left(f(SCR(t))\right)$$

where $f(SCR(t)) = \frac{SCR(t)}{(1+i+6\%)^{t+1}} + \frac{SCR(t)*6\%}{(1+i)^{t+2}} * \sum_{u=1}^{t+1}\left(\frac{(1+i)^u}{(1+i+6\%)^u}\right)$

$$= SCR(t) * [\frac{1}{(1+i+6\%)^{t+1}} + \frac{6\%}{(1+i)^{t+2}} * [\frac{1-(\frac{1+i+6\%}{1+i})^{-(t+1)}}{6\%} * (1+i)]$$ [11]

$$= SCR(t) * [\frac{1}{(1+i+6\%)^{t+1}} + \frac{1-(\frac{1+i+6\%}{1+i})^{-(t+1)}}{(1+i)^{t+1}}]$$

$$= SCR(t) * \frac{(1+i)^{t+1} + (1+i+6\%)^{t+1} - (1+i)^{t+1}}{(1+i+6\%)^{t+1} * (1+i)^{t+1}}$$

$$= SCR(t) * \frac{1}{(1+i)^{t+1}}$$

Hence $COC_{TOT}(0) = 6\% * \sum_{t=0}^{n-1}\left(SCR(t) * \frac{1}{(1+i)^{t+1}}\right)$

$= RM(0)$

⇨ $RM(0) = COC_{SCR}(0) + COC_{RM}(0)$ if the above conditions hold.

EXPRESSION (4)

Let us now introduce a tax rate, *tax%*

Assume that the tax basis is effectively the Solvency II basis (for instance, assuming statutory [taxable] reserves = BEL + Risk Margin)

Given the conditions described, for $t > 0$ distributable profit at time t =

- Interest on *OF'(t-1) (rate i) * (1-tax)*
- + Interest on *RM(t-1) (rate i) * (1-tax)*
- + Release of SCR in time *t*
- + Release of risk margin in time *t * (1-tax)*

$$= OF'(t-1) * i * (1-tax) + RM(t-1) * i * (1-tax) - (SCR(t)-SCR(t-1)) - (RM(t)-RM(t-1)) * (1-tax)$$

$$= SCR(t-1)*(1+i * (1-tax)) - SCR(t) + (RM(t-1)*(1+i) - RM(t))*(1-tax)$$

(because $SCR(t-1) = OF'(t-1)$)

Therefore *NPV (distributable profits)*

$$= OF(0) - SCR(0) + (1-tax) * \sum_{t=1}^{n} \frac{RM(t-1)*(1+i)-RM(t)}{(1+RDR)^t} + \sum_{t=1}^{n} \frac{SCR(t-1)*(1+i*(1-tax))-SCR(t)}{(1+RDR)^t}$$

$$= OF(0) - SCR(0) + (1-tax) * \{RM(0) * (1+i)/(1+RDR) + \sum_{t=1}^{n-1}[RM(t)] * \left(-\frac{1}{(1+RDR)^t} + \frac{1+i}{(1+RDR)^{t+1}}\right)\}$$

$$+ SCR(0) * (1+i*(1-tax))/(1+RDR) + \sum_{t=1}^{n-1}[SCR(t)] * \left(-\frac{1}{(1+RDR)^t} + \frac{1+i*(1-tax)}{(1+RDR)^{t+1}}\right)$$

$$= OF(0) - SCR(0) + (1-tax) * \{RM(0) + (i-RDR) * \sum_{t=0}^{n-1}\left(\frac{RM(t)}{(1+RDR)^{t+1}}\right)\}$$

$$+SCR(0) + (i*(1-tax)-RDR) * \sum_{t=0}^{n-1}\left(\frac{SCR(t)}{(1+RDR)^{t+1}}\right)$$

$$= OF(0) + RM(0)*(1-tax) - COC_{RM}(0) - COC_{SCR}(0)$$

Note that the formula definitions of $COC_{RM}(0)$ and $COC_{SCR}(0)$ now include allowance for tax, and therefore differ from the equivalent definitions in expressions *(1)* to *(3)*. Note also that the formula definitions for $COC_{RM}(0)$ and $COC_{SCR}(0)$ respectively differ from each other since movements in risk margin are assumed to be taxable, whereas movements in SCR are not.

11 Because the summed expression is like the NPV of a stream of cash flows of 1 for t+1 years, at interest rate j where: $(1+j) = (1+i+6\%)/(1+i)$ and hence $j = 6\%/(1+i)$. This $NPV = (1-(1+j)^{-(t+1)}) / j = [1-((1+i+6\%)/(1+i))^{-(t+1)}] / 6\% * (1+i)$.

EXPRESSION (5)

If we then say that $OF'(t) = TSR * SCR(t)$, all the terms in the formulae in the proof of expression *(4)* above involving $SCR(t)$ become $TSR * SCR(t)$, so:

$$NPV\ (distributable\ profits) = OF(0) + RM(0) * (1\text{-}tax) - COC_{RM}(0) - TSR*COC_{SCR}(0)$$

discounted at *RDR*.

EXPRESSION (6)

If we now assume that risky assets earn a margin *m* above risk-free *i* (gross of tax), we get (writing RA*(t)* for total risky assets at time *t*):

$$NPV\ (distributable\ profits) = OF(0) + RM(0)*(1\text{-}tax) - COC_{RM}(0) - TSR * COC_{SCR}(0) + \sum_{t=0}^{n-1} RA(t) * \frac{m*(1-tax)}{(1+RDR)^{t+1}}$$

(with cost of capital measured assuming assets only earn *i*, not *i+m)*

And if we now have to hold $SCR'(t)$ rather than $SCR(t)$ to reflect investment in risky assets:

$$NPV\ (distributable\ profits) = OF(0) + RM(0)*(1\text{-}tax) - COC_{RM}(0) - TSR *COC_{SCR'}(0) + \sum_{t=0}^{n-1} RA(t) * \frac{m*(1-tax)}{(1+RDR)^{t+1}}$$

Therefore, the impact on *NPV (distributable profits)* of investment in risky assets is:

$$-TSR * (COC_{SCR'}(0) - COC_{SCR}(0)) + \sum_{t=0}^{n-1} RA(t) * m * (1-tax) * \frac{1}{(1+RDR)^{t+1}}$$

(with cost of capital still measured assuming assets earn *i*)

If the additional capital $SCR'(t) - SCR(t)$ that is due to investing in risky assets is a constant proportion *p* of the risky assets $RA(t)$, then this becomes:

$$\sum_{t=0}^{n-1} RA(t) * (m * (1-tax) - (RDR - i * (1-tax)) * p * TSR) * \frac{1}{(1+RDR)^{t+1}}$$

EXPRESSION (8)

Consider one year's new business, written with the conditions underlying the proof of expression *(4)* above.

At time 0 (point of sale), the distributable profit is:

$$OF(0) - SCR(0)$$

Where $OF(0)$ is the own funds generated at point of sale, net of tax (before distribution at time 0).

Thereafter, distributable profit at time *t* is as per the proof of expression *(4)*, namely:

$$SCR(t\text{-}1)*(1+i * (1\text{-}tax)) - SCR(t) + (RM(t\text{-}1)*(1+i) - RM(t))*(1\text{-}tax)$$

And *NPV (distributable profits)* is given by:

$$OF(0) - SCR(0) + OF'(0) + RM(0)*(1\text{-}tax) - COC_{RM}(0) - COC_{SCR}(0)$$

Where $OF'(0) = SCR(0)$ (i.e. after distribution at time 0), so *NPV (distributable profits)* is:

$$OF(0) + RM(0)*(1\text{-}tax) - COC_{RM}(0) - COC_{SCR}(0)$$

If we then say $OF(t) = TSR * SCR(t)$, this becomes:

$$OF(0) + RM(0) * (1\text{-}tax) - COC_{RM}(0) - TSR*COC_{SCR}(0)$$

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