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Research Article

Interest Rate Volatility and Life Insurance Solvency: A Technical Analysis of Asset-Liability Management under Solvency II

Alberto Corinti* **and Giuseppe Corvino****

**Guest lecturer at Bocconi University (Committee of European Insurance and Occupational Pensions Supervisors), Itly.*

Tenured Associate Professor of Financial Markets and Institutions at Bocconi University. head of the institutional client business for Italy.

Corresponding Author:
Alberto Corinti, Guest lecturer at Bocconi University (Committee of European Insurance and Occupational Pensions Supervisors), Itly.

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Abstract

The rapid and widespread increase in interest rates has opened a debate on the financial health of Italian life insurance companies and the capacity of the European insurance supervisory regime, Solvency II, to provide a reliable and timely representation of their solvency position. This research contributes to the ongoing discussion regarding the effectiveness of Solvency II in promoting financial stability while supporting the insurance sector's role in long-term financing. Our findings confirm that the Solvency II framework provides effective and early prudential signals both in standard and stressed environments. However, in light of recent, unprecedented market conditions, it could benefit from a targeted review of the calibration process for select parameters, to better balance prudential objectives with the aim to support long-term financing.

The question we aim to address is: how do solvency measurements respond to the unexpected and unprecedented phenomenon of a rapid increase in risk-free interest rates that we recently witnessed? Specifically, does the framework reveal situations of undercapitalization resulting from temporary phenomena that are not adequately interpreted by valuation models, thereby potentially undermining the stability of insurance savings?

To answer this question, our analysis centres on the unavoidable tension between market-consistent valuation principles embedded in Solvency II and the practical challenges of managing long-duration insurance liabilities in volatile interest rate environments. We examine how the key components of the regulatory framework - best estimate liability calculations, risk margin determinations, and Solvency Capital Requirement (SCR) computations - interact with changing interest rate conditions.

JEL Codes: G22, G18, G28

Keywords: Solvency II, Interest Rate Risk, ALM, Asset and Liability Management, Strategic Asset Allocation, Technical Provisions, Duration Matching, Regulatory Capital, Life Insurance, Ultimate Forward Rate, Volatility Adjustment

Introduction

The sudden and widespread increase in interest rates has sparked a debate on the health of Italian life insurance companies and the ability of the European prudential supervision regime, Solvency II, to provide a reliable and timely representation of their financial health. This research contributes to the ongoing debate on the effectiveness of Solvency II in fostering financial stability while supporting the insurance sector's role in long-term financing. Our results confirm that the Solvency II framework offers effective and early prudential signals in both standard and stressed environments. However, given the recent and unprecedented market conditions, it may benefit from a targeted review of the calibration process for specific parameters to better balance prudential objectives with the aim to support long-term financing. The question we seek to answer is: how do solvency measurements respond to the recent, rapid increase in risk-free interest rates—an unexpected and unprecedented phenomenon? Specifically, does the framework identify cases of undercapitalization caused by temporary effects that are not adequately accounted for by valuation models, potentially threatening the stability of insurance savings — or not?

To answer this question, our analysis centres on the unavoidable tension between market-consistent valuation principles embedded in Solvency II and the practical challenges of managing long-duration insurance liabilities in volatile interest rate environments. We examine how the key components of the regulatory framework - best estimate liability calculations, risk margin determinations, and Solvency Capital Requirement (SCR) computations - interact with changing interest rate conditions.

The Study Employs A Multi-Dimensional Approach, Analysing

- The mathematical relationship between discount rate changes and technical provision valuations
- Duration gap dynamics and their impact on solvency ratios
- The effectiveness of regulatory tools such as the Ultimate Forward Rate (UFR) and Matching Adjustment (MA)
- Lapse risk amplification mechanisms under interest rate stress.

The mathematical relationship between discount rate changes and technical provision valuations

To argue the point just made, it is first necessary to revisit some technical aspects regarding how the level of interest rates influences the capitalisation level of a life insurance company under the Solvency II regime.

> For convenience, the regulatory texts underlying what is illustrated from time to time are included in the boxes.

Entering into force in January 2016, Solvency II has radically changed the supervisor's approach to assessing the solvency of insurance companies.

From the very first proposal of the Solvency II Directive (the Directive), the clear intention of the European Institutions was to move away from the previous system centred on cost-based assessments towards a market consistent approach, in line with international developments in accounting and supervision.

> Directive 2009/138
>
> THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, [...] Whereas: [...] (54) The calculation of technical provisions should be consistent with the valuation of assets and other liabilities, market consistent and in line with international developments in accounting and supervision.

The Principles of Solvency II, Useful for our Purposes, Can Thus be Summarized as Follows:

- assets are valued at the amount for which they could be exchanged, between informed and willing parties, in a transaction carried out under normal market conditions;
- the commitments made to policyholders (technical reserves) are valued at the amount for which they could be transferred, between informed and willing parties, in a transaction carried out under normal market conditions.

> Directive 2009/138
>
> Article 75
>
> Valuation of assets and liabilities
>
> 1. Member States shall ensure that, unless otherwise stated, insurance and reinsurance undertakings value assets and liabilities as follows:
>
> (a) assets shall be valued at the amount for which they could be exchanged between knowledgeable willing parties in an arm's length transaction;
>
> (b) liabilities shall be valued at the amount for which they could be transferred, or settled, between knowledgeable willing parties in an arm's length transaction.
>
> When valuing liabilities under point (b), no adjustment to take account of the own credit standing of the insurance or reinsurance undertaking shall be made.

The difference between assets and technical provisions and other liabilities (the own funds, or OF) constitutes the amount of primary resources available to ensure the company's solvency;

the OF must be at least equal to the amount that guarantees the company's solvency in stressed conditions with a confidence level of 99.5% on an annual basis (the solvency capital requirement, or SCR).

The SCR must be calculated with reference to all quantifiable risks to which a company is exposed and must consider both the set of assets and liabilities existing at the valuation date (the "current portfolio") and those expected to be acquired over the next 12 months.

Regarding the current portfolio, the SCR should only consider unexpected losses, as expected losses are implicitly included in the calculation of technical reserves and the market prices of assets.

> Directive 2009/138
>
> Article 100
>
> General provisions
>
> Member States shall require that insurance and reinsurance undertakings hold eligible own funds covering the Solvency Capital Requirement.
>
> Directive 2009/138
>
> Article 101
>
> Calculation of the Solvency Capital Requirement
>
> 2. The Solvency Capital Requirement shall be calculated on the presumption that the undertaking will pursue its business as a going concern.
>
> 3. 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. It shall cover existing business, as well as the new business expected to be written over the following 12 months. With respect to existing business, it shall cover only 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.

Below, the role played by interest rates in the calculation of technical reserves (and, therefore, of the OF) is analysed in detail, along with the SCR and the ratio between these quantities (the solvency ratio).

The influence of interest rates in the calculation of Assuming as well known the role interest rates play in determining the market value of assets, it is appropriate to focus on how they influence the value of technical reserves.

In order for the value of technical reserves to be sufficient to convince an insurance company to undertake the obligations they embed , it must include not only the expected present value of the cash flows arising from future claims payments (the best estimate), but also the cost of capital necessary to remunerate the amount of OF required to cover unexpected losses until the expiration of the commitments (the risk margin).

> Directive 2009/138
>
> Article 77
>
> Calculation of technical provisions
>
> 1. The value of technical provisions shall be equal to the sum of a best estimate and a risk margin [...]

In this context, the level of interest rates plays a substantial role as it influences:
• the expected value of cash flows used to estimate the best estimate, considering clients' propensity to early redeem the insurance policy, also based on the return offered by alternative investments;
• the present value of the cash flows mentioned in the previous point, through the discount rate;
• the cost of capital and the discount rate used to calculate the risk margin.

The expected value of cash flows
• Solvency II prescribes that the future cash flows to be considered for the calculation of the best estimate must include all cash inflows and outflows necessary to settle the company's obligations, weighted by their respective probability of occurrence.

Directive 2009/138

Article 77

Calculation of technical provisions

2. The best estimate shall correspond to the probability-weighted average of future cash-flows [...].

The calculation of the best estimate shall be based upon up-to-date and credible information and realistic assumptions and be performed using adequate, applicable and relevant actuarial and statistical methods.

The cash-flow projection used in the calculation of the best estimate shall take account of all the cash in and out-flows required to settle the insurance and reinsurance obligations over the lifetime thereof.

Imagining a life insurance product whose benefit is solely linked to the rate of return of the assets purchased through the premium income, and assuming:
• that the premium is equal to 100;
• that the product's duration is fixed at 10 years;
• that the best estimate is calculated without discounting the expected cash flows;
• that the maturity yield is distributed according to a discrete distribution with only three possible outcomes — -1%, 3%, and 5% — with probabilities of 20%, 50%, and 30%, respectively.

The best estimate would be 134.15, as shown in the table below.

Best estimate in the case of no return guarantee and discount rate

Premium	Purchased assets	Rate of return	Maturity	Value at maturity	Amount to be paid	Probability	Weighted valu
100,00	100,00	-1,00%	10,00	90,44	90,44	20,00%	18,09
100,00	100,00	3,00%	10,00	134,39	134,39	50,00%	67,20
100,00	100,00	5,00%	10,00	162,89	162,89	30,00%	48,87
							Best estimate = 134,15

Where the contracts sold to policyholders include guarantees or options that can affect the amounts to be paid to policyholders rather than their expiry date, these must necessarily be taken into account for the purpose of calculating the best estimate.

Directive 2009/138

Article 79

Valuation of financial guarantees and contractual options included in insurance and reinsurance contracts.

When calculating technical provisions, insurance and reinsurance undertakings shall take account of the value of financial guarantees and any contractual options included in insurance and reinsurance policies.

Any assumptions made by insurance and reinsurance undertakings with respect to the likelihood that policy holders will exercise contractual options, including lapses and surrenders, shall be realistic and based on current and credible information. The assumptions shall take account, either explicitly or implicitly, of the impact that future changes in financial and non-financial conditions may have on the exercise of those options.

In the context of this work, particular attention should be given to the presence of a "financial performance guarantee" and the "early redemption option" of the position.

The Financial Performance Guarantee

The presence of a guarantee of return inevitably increases the value of the best estimate, as it raises the amount to be paid to policyholders in all cases where the return on the assets purchased through the premium income is lower than what has been promised.

Assuming a return guaranteed that provides a payout to policyholders at least equal to the premium paid (therefore, equal to 0%), the best estimate of the product in the previous example increases by 1.91, rising from 134.15 to 136.06, as illustrated in the table below.

Best estimate in the presence of a guaranteed return and in the case of no discount rate

Premium	Purchased assets	Rate of return	Maturity	Value at maturity	Amount to be paid	Probability	Weighted valu
100,00	100,00	-1,00%	10,00	90,44	100,00	20,00%	20,00
100,00	100,00	3,00%	10,00	134,39	134,39	50,00%	67,20
100,00	100,00	5,00%	10,00	162,89	162,89	30,00%	48,87
							Best estimate = 136,06

The presence of a performance guarantee therefore increases the value of the best estimate, as it forces an upward adjustment of the future cash flows whose amount is less than the minimum guaranteed. This increase in the value of the best estimate (the "cost of the guarantee") is estimated through a stochastic process that, by simulating possible dynamics of the portfolio of assets held by the company, assesses the amount of future cash flows across a sufficiently large number of possible scenarios, and then calculates their expected value. In line with the market-consistent framework of the Directive, the stochastic process takes place in a risk-neutral context that assumes projected expected returns of the asset portfolio consistent with the risk-free term structure. In principle – and all other conditions being equal – a company should benefit from an increase in interest rates, as the number of scenarios in which the return on assets falls below the performance guarantee (which does not change according to the level of interest rates) should decrease. In reality, this is only true if the moment when the interest rate increase occurs coincides with the moment when the premium is received and, therefore, the asset portfolio is purchased.

If the increase occurs at a later time, the final effect for the company – all other conditions being equal – varies depending on the consistency between cash outflows and the maturity of the securities in the portfolio, and in particular:

In the case where a company has a portfolio of assets capable of guaranteeing net cash flows at maturity that are perfectly aligned with the expected net cash flows of liabilities (a situation of "cash flow matching"), such an increase is essentially irrelevant as the maturity value of the securities is unaffected by the interest rate dynamics due to the phenomenon known as the pull to par effect.

In the case where a company has a portfolio of assets capable of guaranteeing net cash flows at a maturity earlier than the expected net cash flows of liabilities (a situation of "cash flow mismatching" due to being "short of duration"), such an increase generates a benefit for the company, which can reinvest the proceeds from the redemption of the securities at a higher rate than the initial one;

Finally, in the case where a company has a portfolio of assets capable of guaranteeing net cash flows at a maturity later than the expected net cash flows of liabilities (a situation of "cash flow mismatching" due to being "long of duration"), such an increase results in losses for the company, which is forced to sell securities early in a rising interest rate environment.

EIOPA, Report on insurers' asset and liability management in relation to the illiquidity of their liabilities, 16 December 2019.

Figure 33: Average weighted duration of all investments with a duration by country

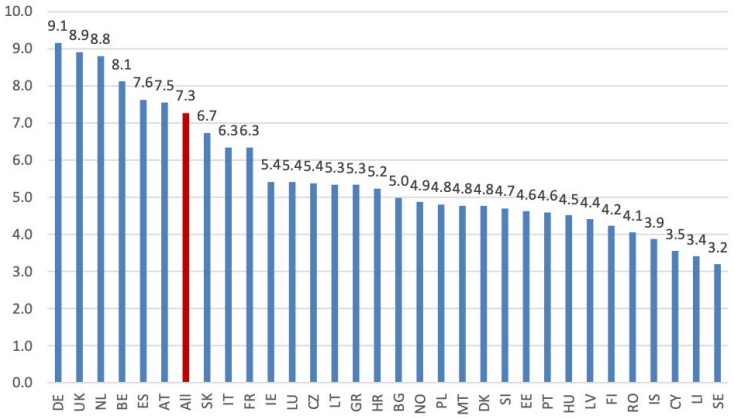
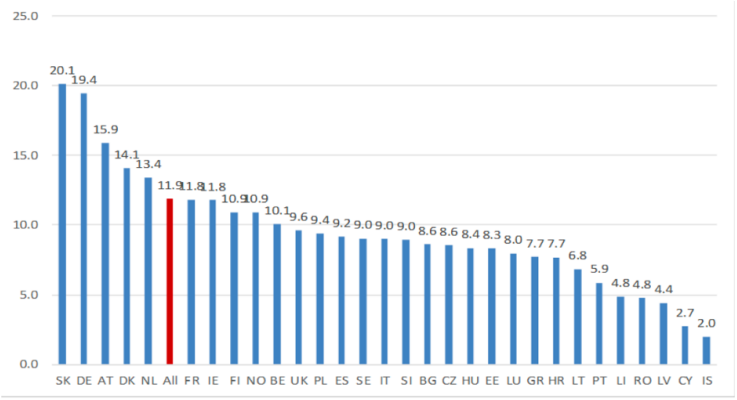


Figure 5: Modified duration per country



There are no homogeneous public data broken down by line of business regarding the mismatch of European companies. However, from data relating to the entire sector, it emerges that Italian companies have a shorter duration of assets compared to liabilities. This difference is, nonetheless, smaller than that observed in countries such as Germany and France, where companies tend to have significantly longer liabilities. Compared to these countries, an increase in interest rates has therefore led to a minor reduction of the best estimate and, consequently, a minor increase of the OF.

The Early Redemption Option

Although cash flow matching allows the company to immunise itself against possible interest rate fluctuations at the time of the benefit payment, the same cannot be said during the life of the product.
Imagining, for simplicity of presentation, a company that at the end of February 2023 had:
• Issued a policy with a return guarantee equal to the swap rate
• Invested the proceeds from the premium in a single risk-free asset without coupons, with a redemption value and maturity date equal to the amount to be paid and assuming five possible maturities for the policy (2, 10, 25, 30, and 50 years), the company would find itself in the situation shown in the table below.

End of February 2023, risk-free rates + 200bps immediately after purchase

	2	**10**	***25***	**30**	**50**
Swap Curve	5,8%	5,2%	4,9%	4,7%	4,3%
Return guarantee	3,8%	3,2%	2,9%	2,7%	2,3%
Premium	92,9	72,8	49,4	44,9	31,8
Amount to be paid	100,0	100,0	100,0	100,0	100,0
Purchased assets	92,9	72,8	49,4	44,9	31,8
Market value of the assets	89,4	60,1	30,5	25,2	12,1
Assets value at maturity	100,0	100,0	100,0	100,0	100,0
Change in Assets	*-3,5*	*-12,7*	*-18,9*	*-19,7*	*-19,7*
Change in assets at maturity	*0,0*	*0,0*	*0,0*	*0,0*	*0,0*

Such short-term volatility is of no relevance when the only cash flow to be covered is related to the natural expiry of the policy, but it becomes inevitably essential when the client has been granted the option to surrender, because in the event of its exercise, the value of the assets must be higher than the amount of the guaranteed benefit.

The combined presence of a return guarantee and a redemption option, therefore makes it impossible to identify a specific date on which to implement a cash flow matching strategy, inevitably leading to an increase in the best estimate because it raises the likelihood of having to face outflows of cash whose amount is less than the market value of the assets available to cover them.

Obviously, companies implement investment strategies that minimise potential mismatches by allocating part of the portfolio to maturities consistent with forecasts regarding the exercise of the redemption option, and the remaining part to other maturities. In this way, the portfolio is made as insensitive as possible to interest rate movements. However, this strategy only works if the assumptions of redemption remain constant over time.

Unfortunately, this is not always the case. If the life insurance product is structured to have a predominantly financial content and does not present substantial disincentives to surrender (as, as we will see shortly, is the case with Italian products), an increase in market interest rates can alter policyholders' propensity to surrender policies with guaranteed interest rates, which were set at a time when market rates were lower, to subscribe products with higher return guarantees. There is a relationship between the level of interest rates and policyholders' willingness to exercise the surrender option. This relationship modifies the cash flow structure used to estimate the best estimate. It therefore must be appropriately incorporated into the stochastic calculation process of the best estimates, through the formalisation of policyholder behaviour (or "PHB").

Disregarding the specific methods by which stochastic simulations aimed at estimating the best estimate are conducted as well as the formalised PHB, the relevant aspect for this work is that the presence of the redemption option causes an increase in the best estimate and therefore a reduction in the OF, whose magnitude is more significant the greater the propensity of clients to redeem, the longer the duration of the assets, and the greater the rise in interest rates between the date of purchase of the securities in the portfolio and the valuation date.

Unlike what happens in other EU countries, Italy has only 1% of the best estimate related to life insurance products with a guaranteed return and no risk of early surrender, compared to 21% in Germany, 16% in France, and 41% in Spain.

EIOPA, Report on insurers' asset and liability management in relation to the illiquidity of their liabilities, 16 December 2019.

Table 3: Share of total BELs ([14]) not exposed to lapse risk

	Line of business ([15])								
	Total	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total	**34%**	**20%**	**80%**	**56%**	**37%**	**74%**	**99%**	**51%**	**77%**
AT	**29%**	30%	19%	-17%	n/a	n/a	89%	n/a	100%
BE	**29%**	4%	99%	n/a	n/a	n/a	100%	n/a	100%
CY	**37%**	0%	59%	145%	n/a	n/a	5%	n/a	31%
CZ	**60%**	48%	100%	80%	n/a	n/a	n/a	n/a	100%
DE	**29%**	21%	55%	8%	99%	n/a	111%	n/a	133%
DK	**79%**	66%	94%	51%	n/a	n/a	51%	n/a	n/a
EE	**79%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EL	**52%**	42%	68%	74%	n/a	n/a	36%	n/a	52%
ES	**67%**	41%	38%	75%	n/a	n/a	n/a	n/a	65%
FI	**84%**	99%	73%	n/a	n/a	n/a	n/a	n/a	n/a
FR	**33%**	16%	98%	54%	33%	66%	88%	38%	60%
HR	**83%**	100%	100%	100%	n/a	n/a	n/a	n/a	78%
HU	**77%**	56%	100%	95%	n/a	100%	-419%	n/a	90%
IE	**99%**	n/a	100%	100%	100%	n/a	n/a	n/a	n/a
IT	**10%**	4%	15%	289%	100%	n/a	n/a	n/a	75%
LI	**99%**	n/a	100%	100%	n/a	n/a	n/a	n/a	n/a
LT	**112%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LU	**90%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LV	**90%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MT	**30%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NL	**59%**	67%	66%	46%	n/a	n/a	98%	32%	93%
NO	**33%**	21%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PL	**66%**	39%	100%	21%	n/a	100%	77%	n/a	100%
PT	**5%**	2%	100%	4%	n/a	n/a	n/a	n/a	n/a
RO	**46%**	76%	78%	29%	n/a	100%	n/a	n/a	-6%
SE	**73%**	73%	73%	100%	n/a	n/a	n/a	n/a	100%
SI	**88%**	81%	98%	43%	n/a	100%	n/a	n/a	100%
SK	**59%**	39%	35%	105%	n/a	n/a	5%	n/a	n/a
UK	**51%**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

([14]) Figures can exceed 100% when undertakings report negative best-estimate values for parts of their business.
([15]) 1, insurance with profit participation; 2, index-linked and unit-linked insurance; 3, other life insurance; 4, accepted reinsurance; 5, annuities stemming from non-life contracts; 6, health insurance; 7, health reinsurance; 8, best-estimate premium provisions (gross).

With reference to Spain, it is worth recalling how, due to this low risk of ransom demands, Spanish companies have been able to benefit significantly from the MA, concerning over 87 billion euros of assets.

EIOPA, Report on insurers' asset and liability management in relation to the illiquidity of their liabilities, 16 December 2019.

Table 42: Breakdown of the Spanish MA portfolios per asset category

	Gross total (€)	Value (%)
Sovereigns	72,453,798,855	83.229
SPVs	1,938,418,053	2.227
Other corporates	12,661,229,655	14.544
Total	87,053,446,564	100.00

Thanks to such an institution provided by Solvency II, Spanish companies could (and can) essentially discount many of their liabilities at the rate of return of the assets rather than according to the rates of the EIOPA curve, achieving a perfect alignment between the discount rates of assets and liabilities.

Directive 2009/138

Article 77b

Matching adjustment to the relevant risk-free interest rate term structure

1. Insurance and reinsurance undertakings may apply a matching adjustment to the relevant risk-free interest rate term structure to calculate the best estimate of a portfolio of life insurance or reinsurance obligations, including annuities stemming from non-life insurance or reinsurance contracts subject to prior approval by the supervisory authorities where the following conditions are met:

(a) the insurance or reinsurance undertaking has assigned a portfolio of assets, consisting of bonds and other assets with similar cash-flow characteristics, to cover the best estimate of the portfolio of insurance or reinsurance obligations and maintains that assignment over the lifetime of the obligations, except for the purpose of maintaining the replication of expected cash flows between assets and liabilities where the cash flows have materially changed;

(b) the portfolio of insurance or reinsurance obligations to which the matching adjustment is applied and the assigned portfolio of assets are identified, organised and managed separately from other activities of the undertakings, and the assigned portfolio of assets cannot be used to cover losses arising from other activities of the undertakings;

(c) the expected cash flows of the assigned portfolio of assets replicate each of the expected cash flows of the portfolio of insurance or reinsurance obligations in the same currency and any mismatch does not give rise to risks which are material in relation to the risks inherent in the insurance or reinsurance business to which the matching adjustment is applied;

(d) the contracts underlying the portfolio of insurance or reinsurance obligations do not give rise to future premium payments;

(e) the only underwriting risks connected to the portfolio of insurance or reinsurance obligations are longevity risk, expense risk, revision risk and mortality risk;

(f) where the underwriting risk connected to the portfolio of insurance or reinsurance obligations includes mortality risk, the best estimate of the portfolio of insurance or reinsurance obligations does not increase by more than 5 % under a mortality risk stress that is calibrated in accordance with Article 101(2) to (5);

(g) the contracts underlying the portfolio of insurance or reinsurance obligations include no options for the policy holder or only a surrender option where the surrender value does not exceed the value of the assets, valued in accordance with Article 75, covering the insurance or reinsurance obligations at the time the surrender option is exercised;

(h) the cash flows of the assigned portfolio of assets are fixed and cannot be changed by the issuers of the assets or any third parties;

(i) the insurance or reinsurance obligations of an insurance or reinsurance contract are not split into different parts when composing the portfolio of insurance or reinsurance obligations for the purpose of this paragraph.

Notwithstanding point (h) of the first subparagraph, insurance or reinsurance undertakings may use assets where the cash flows are fixed except for a dependence on inflation, provided that those assets replicate the cash flows of the portfolio of insurance or reinsurance obligations that depend on inflation.

In the event that issuers or third parties have the right to change the cash flows of an asset in such a manner that the investor receives sufficient compensation to allow it to obtain the same cash flows by re-investing in assets of an equivalent or better credit quality, the right to change the cash flows shall not disqualify the asset for admissibility to the assigned portfolio in accordance with point (h) of the first subparagraph.

With regard to the redemption option, it can therefore be reasonably argued that the increase in interest rates has – in general terms, of course, there are obvious exceptions – resulted in a reduction of the OFs of Italian life insurance companies, even in situations of cash flow matching, both in absolute terms and relative terms.

The Discount Rate of The Best Estimate

In full accordance with the market-consistent approach, Solvency II establishes the principle that the best estimate should be calculated using the term structure of risk-free rates.

Directive 2009/138

Article 77

Calculation of technical provisions

2. The best estimate shall correspond to the probability-weighted average of future cash-flows, taking account of the time value of money (expected present value of future cash-flows), using the relevant risk-free interest rate term structure.

The calculation of the best estimate shall be based upon up-to-date and credible information and realistic assumptions and be performed using adequate, applicable and relevant actuarial and statistical methods.

The cash-flow projection used in the calculation of the best estimate shall take account of all the cash in and out-flows required to settle the insurance and reinsurance obligations over the lifetime thereof.

The best estimate shall be calculated gross, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles. Those amounts shall be calculated separately, in accordance with Article 81.

Based on this principle, a company with a portfolio of risk-free assets capable of ensuring net cash flows perfectly aligned with the expected net cash flows of its liabilities (a "cash flow matching" situation) should have a best estimate equal to the value of its assets, as shown in the table below.

End of February 2023, risk-free rates

	2	**10**	***25***	**30**	**50**
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
Assets	92,9	72,8	49,4	44,9	31,8
Best estimate	92,9	72,8	49,4	44,9	31,8
Own funds	0,0	0,0	0,0	0,0	0,0
Own funds/Best estimate	0,0%	0,0%	0,0%	0,0%	0,0%

The principles outlined in the Directive work as one would expect in a market-consistent world. Unfortunately, however, this is not the case.

If we recalculate the same tables using the method detailed in the Solvency II Delegated Regulation for calculating various balance sheet items, the company's solvency position changes.

As shown in the table below, the value of the best estimate no longer matches that of the asset and becomes, depending on the maturity of the liability, greater or lesser.

As always, the devil is in the details. During the lengthy negotiations that preceded the implementation of the Solvency II supervisory regime, and also considering the extreme volatility of the markets during the financial crises of 2009 and 2011, it became clear that solvency indicators fully consistent with the market would be too sensitive to short-term and non-structural market fluctuations. This could have led to misleading effects and prompted redundant or procyclical interventions by the supervisory authorities. Such effects would have severely penalised the insurance sector and in particular the long-term investments, which are typical of life companies.

A series of measures, known as LTG (Long Term Guarantees) measures, have been incorporated into the Directive that establishes the regime (the Directive) to correct the effects of excessive market volatility and to avaid that abnormal market phases could end up to highligh situations of undercapitalisation – and, therefore, instability of insurance savings – caused solely by temporary phenomena that are not correctly interpreted by valuation models and are negligible in a long-term perspective.

Such "correction" measures impact the market risk factors of investments by smoothing out their volatility, including risk-free interest rates, credit spreads, and stock prices. The risk-free curve to be used for discounting liabilities pursuant to the Delegated Acts is therefore not the swap curve, but a curve that – although risk-free in the statements of the Directive – also takes into account credit risk.

Delegated regulation 2015/35

Article 44

Relevant financial instruments to derive the basic risk-free interest rates

1. For each currency and maturity, the basic risk-free interest rates shall be derived on the basis of interest rate swap rates for interest rates of that currency, adjusted to take account of credit risk.

2. For each currency, for maturities where interest rate swap rates are not available from deep, liquid and transparent financial markets the rates of government bonds issued in that currency, adjusted to take account of the credit risk of the government bonds, shall be used to derive the basic risk free-interest rates, provided that, such government bond rates are available from deep, liquid and transparent financial markets.

This curve (the "EIOPA curve") is calculated according to a precise algorithm and serves as the basis for the calculation of the best estimate.

In late February 2023, the EIOPA curve had the following values.

End of February 2023, risk-free rates and EIOPA Curve

	2	**10**	***25***	**30**	**50**
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
EIOPA Curve	3,7%	3,1%	2,8%	2,9%	3,0%
Delta	-0,1%	-0,1%	0,0%	0,2%	0,7%

As can be observed, in addition to having values different from those expressed by the market, the EIOPA curve also had a different shape: it increased with longer durations, whereas the swap curve decreased.

This phenomenon originated from the fact that the EIOPA curve – in addition to considering credit risk – is constructed under the assumption that long-term rates converge towards a non-market rate.

Delegated regulation 2015/35

Article 46

Extrapolation

1. The principles applied when extrapolating the relevant risk free interest rate term structure shall be the same for all currencies. This shall also apply as regards the determination of the longest maturities for which interest rates can be observed in a deep, liquid and transparent market and the mechanism to ensure a smooth convergence to the ultimate forward rate.

Since beyond certain durations the swap market is not regarded as sufficiently liquid and therefore not representative of actual market conditions, the political and technical bodies of the European Union have established the principle that the EIOPA curve should be calculated assuming that, for long-term maturities, it should tend towards a rate (the ultimate forward rate, or UFR) equal to the sum of:

An expected real rate, to be calculated as the simple arithmetic mean of the annual real rates from 1961 up to the year preceding the recalculation of the UFR for the currency in question; and an expected inflation rate, which essentially coincides with the inflation target rate set by the central bank of the reference currency.

Delegated regulation 2015/35

Article 47

Ultimate forward rate

1. For each currency, the ultimate forward rate referred to in paragraph 1 of Article 46 shall be stable over time and shall only change as a result of changes in long-term expectations. The methodology to derive the ultimate forward rate shall be clearly specified in order to ensure the performance of scenario calculations by insurance and reinsurance undertakings. It shall be determined in a transparent, prudent, reliable and objective manner that is consistent over time.

2. For each currency the ultimate forward rate shall take account of expectations of the long-term real interest rate and of expected inflation, provided those expectations can be determined for that currency in a reliable manner. The ultimate forward rate shall not include a term premium to reflect the additional risk of holding long-term investments.

A very important effect of using the UFR in the calculation of the discount curve for technical reserves is that, regardless of the level of market rates and their volatility, the long part of the EIOPA curve remains anchored to the UFR and is therefore less volatile.

This effect is all the more significant the greater the difference between market rates and the risk-free rate.

In late February 2022, the UFR was still at 3.45%, while the rates were much lower, and the sudden increase recorded a few months later did not change its value.

> EIOPA, Report on the Calculation of the UFR for 2023, 09 March 2022
>
> EIOPA has calculated the ultimate forward rate (UFR) for 2023 in accordance with the methodology to derive the UFR. For the euro, the applicable UFR for 2023 is 3.45%. As the current UFR for the euro is 3.45%, it doesn"t change for the first time since the methodology for deriving the UFR came into effect. In general, the UFR stays the same across all currencies with the exception of the Brazilian real and the Russian ruble. The new ultimate forward rates will be applicable for the first time for the calculation of the risk-free interest rates on 1 January 2023.

The difference between swap rates and the EIOPA curve on long maturities was therefore even greater than that observed at the end of February 2023.

End of February 2023, risk-free rates and EIOPA Curve

	2	**10**	***25***	**30**	**50**
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
EIOPA Curve	3,7%	3,1%	2,8%	2,9%	3,0%
Difference	-0,1%	-0,1%	0,0%	0,2%	0,7%

End of February 2022, risk-free rates and EIOPA Curve

	2	**10**	***25***	**30**	**50**
Swap Curve	0,0%	0,8%	0,9%	0,8%	0,6%
EIOPA Curve	-0,1%	0,7%	1,0%	1,3%	2,1%
Difference	-0,1%	-0,1%	0,1%	0,5%	1,5%

The obvious impacts on the hypothetical company are reported in the following tables.

End of February 2023, risk-free rates

	2	**10**	***25***	**30**	**50**
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
Assets	92,9	72,8	49,4	44,9	31,8
Best estimate	92,9	72,8	49,4	44,9	31,8
Own Funds	0,0	0,0	0,0	0,0	0,0
Own Funds/Best estimate	0,0%	0,0%	0,0%	0,0%	0,0%

End of February 2023, risk-free rates and EIOPA Curve

	2	**10**	***25***	**30**	**50**
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
EIOPA Curve	3,7%	3,1%	2,8%	2,9%	3,0%
Assets	92,9	72,8	49,4	44,9	31,8
Best estimate	93,0	73,6	49,7	42,9	22,3
Own Funds	-0,2	-0,8	-0,3	2,0	9,5
Own Funds/Best estimate	-0,2%	-1,1%	-0,7%	4,8%	42,7%

End of February 2022, risk-free rates

	2	**10**	***25***	**30**	**50**
Swap Curve	0,0%	0,8%	0,9%	0,8%	0,6%
Assets	100,0	92,0	80,1	78,4	73,8
Best estimate	100,0	92,0	80,1	78,4	73,8
Own Funds	0,0	0,0	0,0	0,0	0,0
Own Funds/Best estimate	0,0%	0,0%	0,0%	0,0%	0,0%

End of February 2022, risk-free rates and EIOPA Curve

	2	**10**	***25***	**30**	**50**
Swap Curve	0,0%	0,8%	0,9%	0,8%	0,6%
EIOPA Curve	-0,1%	0,7%	1,0%	1,3%	2,1%
Assets	100,0	92,0	80,1	78,4	73,8
Best estimate	100,2	93,3	77,3	67,8	35,7
Own Funds	-0,2	-1,3	2,8	10,6	38,1
Own Funds/Best estimate	-0,2%	-1,4%	3,6%	15,6%	106,8%

Although a market consistent valuation of companies in cash flow matching should not have led to changes in OF between 2022 and 2023, the level of the company's capitalisation has changed significantly: the distorting effect of the UFR has inevitably allowed companies with longer-term commitments (such as the German ones) to substantially mitigate the emergence of low-solvency positions during the period of low or negative interest rates, while those with shorter-term liabilities (such as the Italian ones) have been negatively affected, albeit in a completely marginal way.

EIOPA, Report on insurers' asset and liability management in relation to the illiquidity of their liabilities, 16 December 2019.

Figure 15: Weighted Average modified duration of liabilities per country[24]

	Line of business[25]								
	Total	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Non-life**
Total	**11.9**	12.9	11.5	12.7	11.2	12.8	26.1	13.6	4.6
AT	**15.9**	14.3	10.6	-2.9	7.1	15.8	87.5	2.0	6.2
BE	**10.1**	10.2	8.4	6.0	9.6	13.7	42.0	1.4	4.9
BG	**8.6**	12.4	10.6	3.8	2.2	16.3	-	1.0	6.0
HR	**7.7**	8.7	6.3	-1.6	-	12.4	7.4	-	4.4
CY	**2.7**	6.5	4.0	11.5	6.6	-	4.0	-	2.2
CZ	**8.6**	10.2	7.8	5.2	8.6	13.8	13.4	-36.0	3.8
DK	**14.1**	15.4	12.8	6.5	-	10.6	8.5	-	4.4
EE	**8.3**	13.3	8.8	9.3	-	10.6	3.2	-	2.3
FI	**10.9**	11.1	9.8	12.2	12.7	13.2	11.6	-	6.6
FR	**11.8**	12.6	12.4	10.6	12.7	10.6	8.7	9.0	5.8
DE	**19.4**	18.2	31.9	10.7	-12.4	14.6	31.9	21.6	7.3
GR	**7.7**	9.1	9.9	9.1	-	6.1	10.9	-	3.5
HU	**8.4**	9.0	11.3	-8.7	-	17.6	5.5	-	3.6
IE	**11.8**	15.5	8.7	19.1	11.2	19.0	7.3	8.1	4.5
IT	**9.0**	9.5	8.2	9.8	7.1	18.0	78.3	9.4	3.4
LV	**4.4**	6.6	3.5	3.1	-	13.7	9.8	-	1.5
LI	**4.8**	6.3	10.2	14.1	3.0	-	-	-	3.4
LT	**6.8**	11.6	7.9	7.9	-	13.4	8.7	-	1.9
LU	**8.0**	8.9	12.5	4.3	-64.4	-	3.1	21.7	6.8
NL	**13.4**	15.5	12.8	14.4	13.6	6.5	9.3	3.4	2.3
NO	**10.9**	14.1	12.4	12.3	-	11.4	10.5	-	4.4
PL	**9.4**	9.2	5.1	17.5	1.0	16.9	8.2	-	4.2
PT	**5.9**	6.4	6.5	4.3	3.6	12.7	12.5	-	3.2
RO	**4.8**	8.6	3.0	-	1.0	6.4	4.8	-	2.0
SK	**20.1**	13.9	6.7	50.8	2.1	11.5	7.2	8.5	4.1
SI	**9.0**	10.9	13.1	24.8	14.0	16.7	4.1	-	2.6
ES	**9.2**	8.7	3.4	10.6	3.5	14.3	8.3	36.5	2.3

23 The difference can be important if the cash flows are heavily dependent on the interest rates. This is because of future discretionary benefits.

24 QRT Sample except MT due to data issues.

25 1: insurance with profit participation, 2: index-linked and unit linked insurance, 3: other life insurance, 4: accepted reinsurance, 5: annuities streaming from non-life contracts, 6: health insurance, 7: health reinsurance

About the UFR, it can therefore be reasonably argued that its presence has, in general terms, not caused significant distortions in the calculation of the OFs of Italian life insurance companies in a position of cash flow matching.
This conclusion, however, is only true in absolute terms.

In relative terms, the opposite cannot be said: a generic Italian company (with liabilities averaging 9.5 years for products with a guaranteed return) in cash flow matching has a lower OF level than a generic German company (with liabilities averaging 18.2 years for products with a guaranteed return).

The two OFs are therefore not comparable, even though they are identical from a market-consistent perspective.

The Calculation of the Risk Margin

Finally, the level of interest rates affects the level of technical reserves because it impacts the risk margin, which must be calculated considering both their level and the company's cost of capital.

Without delving into the technicalities of the risk margin calculation, this component is already considered within the Directive, not in a market-consistent logic, and is set equally for all companies, regardless of each one's specific cost of funding.

Directive 2009/138

Article 77

Calculation of technical provisions

3. The risk margin shall be such as to ensure that the value of the technical provisions is equivalent to the amount that insurance and reinsurance undertakings would be expected to require in order to take over and meet the insurance and reinsurance obligations.

4. Insurance and reinsurance undertakings shall value the best estimate and the risk margin separately. However, where future cash flows associated with insurance or reinsurance obligations can be replicated reliably using financial instruments for which a reliable market value is observable, the value of technical provisions associated with those future cash flows shall be determined on the basis of the market value of those financial instruments. In this case, separate calculations of the best estimate and the risk margin shall not be required.

5. Where insurance and reinsurance undertakings value the best estimate and the risk margin separately, the risk margin shall be calculated by determining the cost of providing an amount of eligible own funds equal to the Solvency Capital Requirement necessary to support the insurance and reinsurance obligations over the lifetime thereof.

The rate used in the determination of the cost of providing that amount of eligible own funds (Cost-of-Capital rate) shall be the same for all insurance and reinsurance undertakings and shall be reviewed periodically.

The Cost-of-Capital rate used shall be equal to the additional rate, above the relevant risk-free interest rate, that an insurance or rein- surance undertaking would incur holding an amount of eligible own funds, as set out in Section 3, equal to the Solvency Capital Requirement necessary to support insurance and reinsurance obli- gations over the lifetime of those obligations.

The Calculation of the SCR

The above point concerns the amount of a company's assets and liabilities, and therefore the amount of OFs available to cover the SCR.

Among the various risks to consider when calculating the SCR, two are of particular importance in a context of rising interest rates.:

The obvious risk arising from the sensitivity of the value of assets and technical reserves to unexpected changes in the term structure of interest rates or in the related volatility (the "interest rate risk" component of the SCR) – falling within market risks;

The risk arising from the unexpected exercise of the redemption option (the "lapse risk" component of the SCR) – falling under underwriting risks for life insurance.

As seen in the paragraph dedicated to the PHB, in life business with a guarantee of return, it is impossible to separate lapse risk and interest rate risk: the same amount of surrenders can generate losses or gains solely depending on the level of interest rates at the time of valuation. An increase generally causes losses, while a decrease does not.

This aspect is of crucial importance for the purposes of this work and deserves further examination. The SCR – that is, the interest rate risk and the lapse risk module – can be calculated either through a standard methodology (the 'standard formula") or using an internal model.

Directive 2009/138

Article 100

General provisions

The Solvency Capital Requirement shall be calculated, either in accordance with the standard formula in Subsection 2 or using an internal model, as set out in Subsection 3.

According to the standard formula (used by most companies), the interest rate risk in the case of rising rates (the "Up" scenario) is calculated by increasing the EIOPA curve by a certain percentage range, from 70% for maturities of one year to 20% for maturities of 90 years (with 26% for the 20-year maturity and 42% for the 10-year maturity). In any case, the increase must be at least equal to one.

Delegated regulation 2015/35

Article 166

Increase in the term structure of interest rates

1. The capital requirement for the risk of an increase in the term structure of interest rates for a given currency shall be equal to the loss in the basic own funds that would result from an instantaneous increase in basic risk-free interest rates for that currency at different maturities in accordance with the following table:

Maturity (in years)	Increase
1	70 %
2	70 %
3	64 %
4	59 %
5	55 %
6	52 %
7	49 %
8	47 %
9	44 %
10	42 %
11	39 %
12	37 %
13	35 %
14	34 %
15	33 %
16	31 %
17	30 %
18	29 %
19	27 %
20	26 %
90	20 %

For maturities not specified in the table above, the value of the increase shall be linearly interpolated. For maturities shorter than 1 year, the increase shall be 70 %. For maturities longer than 90 years, the increase shall be 20 %.

2. In any case, the increase of basic-risk-free interest rates at any maturity shall be at least one percentage point.

At the end of February 2023 and at the end of February 2022, the rates to consider for evaluating the Up scenario were those listed below.

End of February 2023, risk-free rates and EIOPA Curve in Up Scenario

	Premium	**Purchased assets**	**10**	***25***	**Value at maturity**	**Amount to be paid**
Swap Curve	3,8%	3,4%	3,2%	2,9%	2,7%	2,3%
EIOPA Curve	3,7%	3,3%	3,1%	2,8%	2,9%	3,0%
Up Scenario	6,3%	5,1%	4,4%	3,8%	3,8%	4,0%
Up Scenario - EIOPA Curve	2,6%	1,8%	1,3%	1,0%	1,0%	1,0%

End of February 2022, risk-free rates and EIOPA Curve in Up Scenario

Weighted value	**2**	**5**	**10**	***25***	**30**	**50**
Swap Curve	0,0%	0,5%	0,8%	0,9%	0,8%	0,6%
EIOPA Curve	-0,1%	0,4%	0,7%	1,0%	1,3%	2,1%
Up Scenario	0,9%	1,4%	1,7%	2,0%	2,3%	3,1%
Up Scenario - EIOPA Cu	1,0%	1,0%	1,0%	1,0%	1,0%	1,0%

The significance of such a substantial rate change in terms of SCR can be demonstrated by examining how exercising the redemption option at the end of February 2023 impacts a company's OF, which, at the end of February 2022, involved selling a life policy with a surrender option that offers: a premium of 100; a predefined maturity (chosen from 2, 5, 10, 25, 30, or 50 years in subsequent tables); a guaranteed return rate that matches market rates if maintained until maturity; the return of the premium upon surrender; and investing the received premium in a zero-coupon bond maturing simultaneously with the policy and with a return rate aligned with market rates.

The company's situation at the time of the policy sale is shown in the table below.

End of February 2022

	2	**5**	**10**	***25***	**30**	**50**
Swap Curve Feb 2022	*0,0%*	*0,5%*	*0,8%*	*0,9%*	*0,8%*	*0,6%*
Premium	100,0	100,0	100,0	100,0	100,0	100,0
Initial assets value	100,0	100,0	100,0	100,0	100,0	100,0
Redemption value	100,0	102,3	108,7	124,9	127,6	135,5
Amount due at maturity	100,0	102,3	108,7	124,9	127,6	135,5
Amount due in redemption	100,0	100,0	100,0	100,0	100,0	100,0
EIOPA Curve	*-0,1%*	*0,4%*	*0,7%*	*1,0%*	*1,3%*	*2,1%*
Best estimate (no PHB)	100,2	100,5	101,4	96,6	86,5	48,4
Own funds (no PHB)	-0,2	-0,5	-1,4	3,4	13,5	51,6
Own funds (no PHB) / best estimate	-0,2%	-0,5%	-1,4%	3,6%	15,6%	106,8%

It is clearly evident that the increase in interest rates observed during the year results in significant losses in the event of early redemption, both in the "base" scenarios and in the stress scenario used for the SCR calculation, even though the hypothetical company considered has perfect cash flow matching between assets and liabilities.

End of February 2023, after redemptions

	2	**5**	**10**	***25***	**30**	**50**
Swap Curve Feb 2023	3,8%	3,4%	3,2%	2,9%	2,7%	2,3%
Proceeds from the asset sale	96,41	89,60	81,63	63,46	58,86	44,07
Redemption rate	100%	100%	100%	100%	100%	100%
Amount paid for redemptions	100,00	100,00	100,00	100,00	100,00	100,00
Best estimate (no PHB)	0,00	0,00	0,00	0,00	0,00	0,00
Own funds (no PHB)	-3,59	-10,40	-18,37	-36,54	-41,14	-55,93
Change in own funds (no PHB)	3,39	9,91	16,98	39,97	54,66	107,58

Own funds in the Up Scenario

	2	**5**	**10**	***25***	**30**	**50**
Up Scenario Feb 2023	6,3%	5,1%	4,4%	3,8%	3,8%	4,0%
Initial assets value	94,15	83,94	73,51	50,75	42,67	19,49
Redemption rate	100%	100%	100%	100%	100%	100%
Redemptions	100,00	100,00	100,00	100,00	100,00	100,00
Losses	-5,85	-16,06	-26,49	-49,25	-57,33	-80,51
Losses 2023/Assets 2022	-5,85%	-16,06%	-26,49%	-49,25%	-57,33%	-80,51%

This valuation assumes a complete redemption of the portfolio. For the purpose of calculating the SCR for lapse risk, it is necessary – among other things – to estimate what happens in the event of redemptions amounting to 40% of the total policies in force (the "mass lapse" risk). Returning to the previous example, this involves simulating the disposal of 40% of the securities portfolio (the remaining 60% cannot be disposed of because it is needed to finance 60% of the remaining policies), resulting in the losses shown in the table below.

"Cost" of 40% redemptions in Up Scenario

	2	5	10	25	30	50
Up Scenario Feb 2023	6,3%	5,1%	4,4%	3,8%	3,8%	4,0%
Initial assets value	94,15	83,94	73,51	50,75	42,67	19,49
Redemption rate	40%	40%	40%	40%	40%	40%
Redemptions	40,00	40,00	40,00	40,00	40,00	40,00
Losses	-2,34	-6,43	-10,59	-19,70	-22,93	-32,20
Losses 2023/Assets 2022	-2,34%	-6,43%	-10,59%	-19,70%	-22,93%	-32,20%

As it is evident, the recent dynamics of interest rates combined with the Up scenario / 40% of redemptions generate a significant SCR even with relatively short maturities.

Obviously, it can be argued that a scenario of a 40% maximum lapse rate, equal for all companies, does not align with the intention of the Directive to calibrate the risk at 99.5%, as each company has its own specific characteristics in terms of customer propensity to surrender.

The Directive overcomes this objection through two tools.
The first involves adopting specific internal modelling within the company.

> Directive 2009/138
>
> Article 100
>
> General provisions
>
> The Solvency Capital Requirement shall be calculated, either in accordance with the standard formula in Subsection 2 or using an internal model, as set out in Subsection 3.

The adoption of internal models, however, is only undertaken by large groups for obvious cost-saving reasons. The second involves the possibility of replacing, subject to approval by the supervisory authorities, a subset of the parameters of the standard formula with enterprise-specific parameters ("undertaking-specific parameters"), which are appropriately calibrated based on the internal data of the interested enterprise.

> Directive 2009/138
>
> Article 104
>
> Design of the Basic Solvency Capital Requirement
>
> 7. Subject to approval by the supervisory authorities, insurance and reinsurance undertakings may, within the design of the standard formula, replace a subset of its parameters by parameters specific to the undertaking concerned when calculating the life, non-life and health underwriting risk modules.
>
> Such parameters shall be calibrated on the basis of the internal data of the undertaking concerned, or of data which is directly relevant for the operations of that undertaking using standardised methods.
>
> When granting supervisory approval, supervisory authorities shall verify the completeness, accuracy and appropriateness of the data used.

However, this opportunity was not granted with regard to the mass lapse risk

Interest Rates in Operational Assessments

The above-mentioned also has clear implications in what-if assessments conducted outside regulatory contexts, where scenarios of parallel interest rate curve movements are usually hypothesised.

Assuming a 200-basis-point rise in risk-free rates across all maturities, we would not expect any impact on the solvency level of the company mentioned in the previous examples, as shown in the table below.

End of February 2023, risk-free rates + 200bps

	2	10	25	30	50
Swap Curve	5,8%	5,2%	4,9%	4,7%	4,3%
Assets	89,4	60,1	30,5	25,2	12,1
Best estimate	89,4	60,1	30,5	25,2	12,1
Own funds	0,0	0,0	0,0	0,0	0,0
Own funds/Best estimate	0,0%	0,0%	0,0%	0,0%	0,0%

We would therefore expect that such stress does not impact the level of the considered company.

Again, the devil is in the details.
As shown in the table below, the value of the liability no longer coincides with the value of the asset and becomes larger, depending on the time horizon considered.

End of February 2023, risk-free rates and EIOPA Curve + stress

	2	10	25	30	50
Swap Curve	5,8%	5,2%	4,9%	4,7%	4,3%
Assets	89,4	60,1	30,5	25,2	12,1
Best estimate	89,4	60,8	32,3	27,1	13,6
Own funds	0,0	-0,7	-1,8	-1,9	-1,5
Own funds/Best estimate	0,0%	-1,2%	-5,6%	-6,9%	-11,3%

Although the stress assumes an increase of 200 basis points across all swap rate maturities, the rise in the EIOPA curve is not of the same magnitude: since the UFR is lower than the increased swap rates by 200 basis points, the increase in EIOPA rates tends to decrease as the maturities lengthen because the long-term part remains anchored at 3.45%; as shown in the table below.

End of February 2023, EIOPA Curve and EIOPA Curve + stress

	2	10	25	30	50
EIOPA Curve	3,7%	3,1%	2,8%	2,9%	3,0%
EIOPA Curve + stress	3,7%	5,1%	4,6%	4,5%	4,1%
Difference	0,0%	2,0%	1,8%	1,6%	1,0%

Before proceeding to some conclusions that could be drawn from this work, it is appropriate to recall two additional technical aspects.

The first is that the impact of the UFR on the Solvency II values of companies varies depending on the level of market rates, and particularly on the distance between them and the UFR.

In a single year, the context can change dramatically: at the end of February 2022, the UFR was still at 3.45% (the sudden increase recorded in 2022, following nearly a decade of low rates, did not affect the final outcome), while the rates were significantly lower. The difference between swap rates and the EIOPA curve was therefore still greater than that observed at the end of February 2023.

End of February 2023, risk-free rates and EIOPA Curve

	2	10	25	30	50
Swap Curve	3,8%	3,2%	2,9%	2,7%	2,3%
EIOPA Curve	3,7%	3,1%	2,8%	2,9%	3,0%
Difference	-0,1%	-0,1%	0,0%	0,2%	0,7%

End of February 2022, risk-free rates and EIOPA Curve

	2	10	25	30	50
Swap Curve	0,0%	0,8%	0,9%	0,8%	0,6%
EIOPA Curve	-0,1%	0,7%	1,0%	1,3%	2,1%
Difference	-0,1%	-0,1%	0,1%	0,5%	1,5%

The obvious impacts on the hypothetical company are reported in the following tables.

End of February 2023, risk-free rates and EIOPA Curve

	10	25	30	50
Swap Curve	3,2%	2,9%	2,7%	2,3%
Assets	72,8	49,4	44,9	31,8
Best estimate	73,6	49,7	42,9	22,3
Own funds	-0,8	-0,3	2,0	9,5
Own funds/Best estimate	-1,1%	-0,7%	4,8%	42,7%

End of February 2022, risk-free rates and EIOPA Curve

	10	25	30	50
Swap Curve	0,8%	0,9%	0,8%	0,6%
Assets	92,0	80,1	78,4	73,8
Best estimate	93,3	77,3	67,8	35,7
Own funds	-1,3	2,8	10,6	38,1
Own funds/Best estimate	-1,4%	3,6%	15,6%	106,8%

Although a market consistent valuation should not have led to capital changes in the case of perfect cash flow matching, the company's level of capitalisation has changed significantly between February 2023 and February 2022.

This effect obviously also applies in stress scenarios, as illustrated in the following tables.

End of February 2023, risk-free rates and EIOPA Curve + stress

	10	25	30	50
Swap Curve	5,2%	4,9%	4,7%	4,3%
Assets	60,1	30,5	25,2	12,1
Best estimate	60,8	32,3	27,1	13,6
Own funds	-0,7	-1,8	-1,9	-1,5
Own funds/Best estimate	-1,2%	-5,6%	-6,9%	-11,3%

End of February 2022, risk-free rates and EIOPA Curve + stress

	10	25	30	50
Swap Curve	2,8%	2,9%	2,8%	2,6%
Assets	75,6	49,0	43,5	27,6
Best estimate	76,4	49,2	42,0	21,6
Own funds	-0,8	-0,2	1,5	6,0
Own funds/Best estimate	-1,1%	-0,3%	3,5%	27,9%

Although a market-consistent valuation should not have led to capital variations in the case of perfect cash flow matching, the company's ability to absorb stress scenarios with rising interest rates has significantly changed between February 2023 and February 2022.

Since the stressed swap rates were still lower than the UFR in February 2022, the stressed EIOPA curve increases with longer maturities, rather than decreasing as it did in February 2023.

End of February 2023, EIOPA Curve and EIOPA Curve + stress

	10	25	30	50
EIOPA Curve	3,1%	2,8%	2,9%	3,0%
EIOPA Curve + stress	5,1%	4,6%	4,5%	4,1%
Difference	2,0%	1,8%	1,6%	1,0%

End of February 2022, EIOPA Curve and EIOPA Curve + stress

	10	25	30	50
EIOPA Curve	0,7%	1,0%	1,3%	2,1%
EIOPA Curve + stress	2,7%	2,9%	2,9%	3,1%
Difference	2,0%	1,8%	1,6%	1,0%

An important consideration for the purposes of this work is the distorting effect of the UFR, which results in non-market-consistent undercapitalization for the company with ten-year liabilities and an equally non-market-consistent overcapitalization for the company with longer-term liabilities. This effect is even more pronounced when considering stress scenarios involving rising interest rates.

The second technical aspect to address relates to the fact that everything mentioned so far is based on at least one underlying assumption: the company pursues a cash flow matching strategy. In reality, it could also follow a duration-matching strategy by constructing a diversified portfolio with a duration that match the duration of the liabilities.

The ten-year expiry of the previous table could be replicated through a strategy involving the purchase of money market instruments (which we will refer to as Asset 1) and a risk-free, non-coupon-paying bond with a 30-year maturity (which we will refer to as Asset 2), as shown in the table below.

End of February 2023, risk-free rates and EIOPA Curve

Weighted value	Present value	0	10	30
Swap Curve			3,2%	2,7%
EUIPA Curve			3,1%	
Asset 1	39,4	39,4		
Asset 2	33,3			74,2
Total assets	72,8			
Best estimate	73,6		100,0	
Own funds	-0,8			
Own funds/Best estimate	-1,1%			

Suppose the initial value of the individual items does not change – by definition – at the time of the initial valuation. In that case, unfortunately, the same cannot be said for stress.

As can be inferred from and highlighted in the table below, the duration matching strategy is significantly more sensitive to rising interest rates, resulting in a change in capital that amounts to 4.4% of the reserves, rather than 1.1%.

End of February 2023, risk-free rates and EIOPA Curve + stress

	Present value	0	10	30
Swap Curve			5,2%	4,7%
EUIPA Curve			5,1%	
Asset 1	39,4	39,4		
Asset 2	18,7			74,2
Total assets	58,1			
Best estimate	60,8		100,0	
Own funds	-2,7			
Own funds/Best estimate	-4,4%			

This variation in capital becomes increasingly important as the maturity of liabilities lengthens, due to the greater impact of the UFR in terms of differing volatility at longer maturities.

It follows that the greater the mismatch between the maturities of assets and liabilities, the greater the company's exposure to interest rate fluctuations.

The exposure of each individual company, therefore, also varies depending on the commercial policy and the investment strategy pursued.

The Commercial Policy

An increase in interest rates creates a misalignment of interests between companies, distribution networks, and clients, where:
• the former have an interest in maintaining products in their portfolio and increasing their collection in order to purchase higher-yielding securities;
• distributors might be interested in redeeming products to market other products capable of guaranteeing a new commission flow;
• and clients might be interested in redeeming products with a lower guaranteed return rate to subscribe to others.

The tools for aligning such interests are different.

Firstly, there are the product policies. The application of penalties in the event of redemption allows the interests of the companies and clients to be aligned. Clients can enjoy the benefits of with profit contracts ("gestioni separate") through:
• financial returns that outperform the market during periods of declining or low interest rates (as seen over the past approximately 10 years), in exchange for lower returns during times of rising rates (as experienced in the last year or so), consistent with the intertemporal mutuality logic of returns among policyholders underlying revaluing first branch products
• the possibility of avoiding the losses that the direct purchase of bond securities generates during the phases of rising interest rates.
• Obviously, penalties constitute a potential cost for both clients (in the event of redemption) and companies (in terms of lower sales volumes): managing this balance between benefits and costs makes a difference in scenarios of rising interest rates.

For managing this trade-off, the level of financial education of clients, the quality of service provided by distribution networks, and the strategic alignment of interests between them and the companies are crucial.

The cases in which such possible misalignments of interests have not been properly managed with appropriate product and governance policies are, of course, not comparable to those in which this has not occurred.

The Investment Strategy

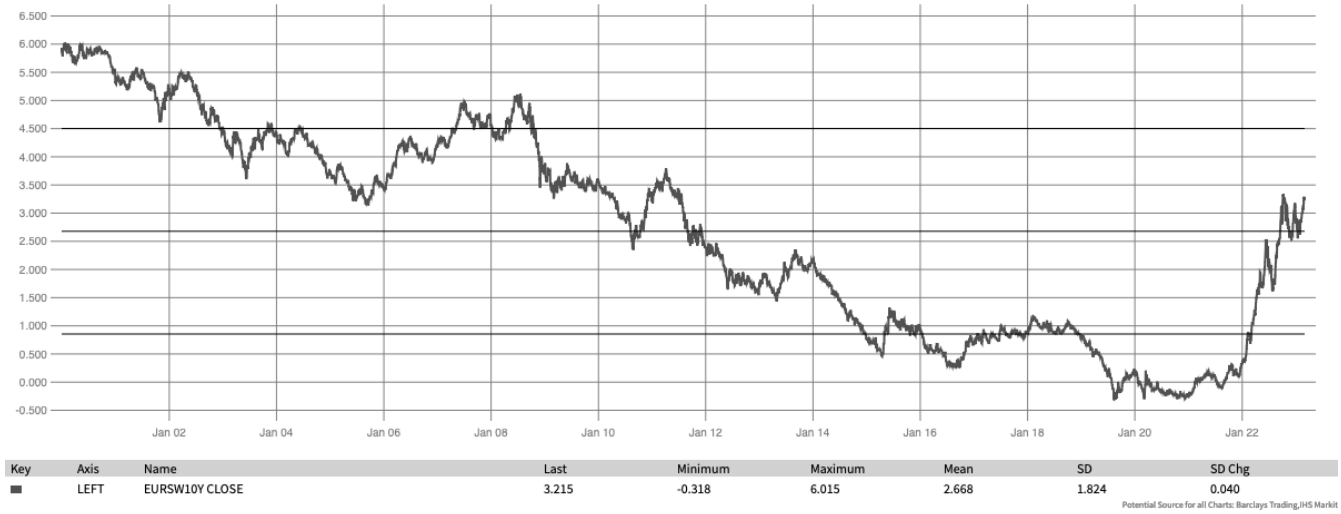
As previously seen, the UFR and the deviation from perfect cash flow matching amplify the negative effects of an interest rate increase.

The relative risk therefore varies depending on the investment strategy adopted by each company in terms of portfolio construction: companies that have invested part of their portfolio in the long term (even if with the same duration) are not comparable to those that have adhered to a more strict cash flow matching approach.

Conclusions

Until today, the Solvency II system has worked excellently: it has driven investments in risk control systems and procedures, playing a fundamental role in the industry's resilience during the period of low interest rates and rising spreads.

The system has been shapedin order to mitigate the impact of these risk factors: the first through the introduction of the UFR (which, as previously seen, has helped companies manage the decline in rates), the second through the VA.
The UFR would have also worked during a phase of rising risk-free rates, if this had manifested itself with the timing it has historically shown, but the increase in 2022 had never occurred before.



Key	Axis	Name	Last	Minimum	Maximum	Mean	SD	SD Chg
■	LEFT	EURSW10Y CLOSE	3.215	-0.318	6.015	2.668	1.824	0.040

Potential Source for all Charts: Barclays Trading,IHS Markit

It would be important that Authorities – at any level, political and supervisory – commit to a review process that adapts the Solvency II rules to the new context, "maintaining" the aspects of the regulation that, not being market consistent, were conceived in a completely different setting.

Our research identifies at least three key technical parameters whose calibration warrants closer examination:

UFR: Our analysis shows that the current process and methodology for deriving the Risk-Free Interest Rate Term Structure and the UFR - although intended to provide long-term stability - may, under certain circumstances, have the counterintuitive effect of amplifying market dynamics. This observation underscores the need for a targeted refinement to ensure resilience and appropriate risk sensitivity under both standard and exceptional market conditions. It would be advisable to introduce calculation rules that incorporate more frequent updates of the UFR and assign greater weight to more recent historical data using a decay factor approach, in order to adapt to the "new" volatility of interest rates.

Lapse Risk: Under Solvency II standard formula, an increase in interest rates can activate multiple stress scenarios simultaneously. Among these, the mass lapse shock - modelled as an immediate surrender of 40% of policies - becomes particularly severe when higher rates determine asset valuation losses and make alternative investments more appealing to policyholders. This is due to the excessive severity of this shock in case the company – because of their portfolio features and distribution channels – is not so exposed to lapses, but also because the 40% surrender rate is applied to portfolios that may have already experienced substantial prior lapses; the result is that the SCR escalates precisely at a moment when the available capital for more flexible, yield-enhancing investment strategies is reduced. This restricts insurers' capacity to offer policyholders returns that are more competitive with those available from alternative assets. The interplay of these mechanisms can create a feedback loop, whereby deteriorating market conditions lead to increased regulatory capital requirements, further limiting business resilience and financial flexibility.

It would be advisable to introduce the possibility of customising the level of these factors in stress analyses based on the specific characteristics of the various companies, given the importance that this source of risk has now assumed and as already permitted by the Directive.

> Directive 2009/138
>
> Article 104
>
> Design of the Basic Solvency Capital Requirement
>
> 7. Subject to approval by the supervisory authorities, insur- ance and reinsurance undertakings may, within the design of the standard formula, replace a subset of its parameters by parameters specific to the undertaking concerned when calculating the life, non-life and health underwriting risk modules.
>
> Such parameters shall be calibrated on the basis of the internal data of the undertaking concerned, or of data which is directly rel- evant for the operations of that undertaking using standardised methods.
>
> When granting supervisory approval, supervisory authorities shall verify the completeness, accuracy and appropriateness of the data used.

This possibility has been granted to date with reference to other types of risk, but given the importance that the risk of redemptions has assumed in the new context, it would be appropriate to revisit the assessments on the illiquidity of liabilities that EIOPA had already developed in its 2019 report mentioned above.

Delegated regulation 2015/35

Article 218

Subset of standard parameters that may be replaced by undertaking-specific parameters

1. The subset of standard parameters that may be replaced by undertaking-specific parameters as set out in Article 104(7) of Directive 2009/138/EC shall comprise the following parameters:

(a) in the non-life premium and reserve risk sub-module, for each segment set out in Annex II of this Regulation [...];

(b) in the life revision risk sub-module, the increase in the amount of annuity benefits referred to in Article 141 of this Regulation, provided that the annuities falling under that sub-module are not subject to material inflation risk [...];

(c) in the NSLT health premium and reserve risk sub-module, for each segment set out in Annex XIV of this Regulation [...]:

(d) in the health revision risk sub-module, the increase in the amount of annuity benefits referred to in Article 158 of this Regulation, provided that the annuities falling under that sub-module are not subject to material inflation risk [...].

Insurance and reinsurance undertakings shall not replace both the standard parameters referred to in point (a)(ii) and (iii) of the same segment or both the standard parameters referred to in point (c)(ii) and (iii) of the same segment.

MA: The heterogeneous application of the MA across different national jurisdictions within the Solvency II framework can result in competitive distortions, as insurers subject to more flexible or advantageous implementation regimes may benefit from a disproportionate reduction in regulatory capital requirements. These disparities risk undermining the level playing field that Solvency II aims to establish for insurers operating within the Single Market. To address this issue, it would be appropriate to precisely define the operational characteristics and eligibility criteria of the MA, ensuring harmonisation in approval processes and asset and liability requirements. A common and transparent approach would enhance market stability and support fair competition in the European insurance industry. Such targeted regulatory clarification would preserve the prudential aims of the framework, while minimising detrimental competitive effects resulting from national divergences in the application of the MA.

A targeted review of these parameters would not only strengthen the stability and competitiveness of the insurance industry but also generate tangible benefits for policyholders, fully in line with the policyholder protection principle, by enabling a more efficient allocation of the assets under management. In accordance with the prudent person principle of Solvency II, this would also allow insurers to deploy a greater share of resources into productive, long-term real economy investments, thereby enhancing returns, bolstering market resilience, and fostering sustainable economic growth

Meanwhile, it is equally essential that supervisory authorities interpret Solvency II evidence in a manner that allows them to discern the risks actually inherent in different companies, as well as those that result from non-market-consistent assumptions, which can lead to risks being highlighted inappropriately.

Finally, it is equally essential that the industry adopts distribution and product strategies in line with the new context, also exploiting the margins offered by the current Solvency II system. From this perspective, the ability to capture the actual risk profile offered by the adoption of internal models and the possibility of applying the MA in the event of adopting the standard formula deserve particular attention and priority.

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