BY FRANK VAN BERKUM

Longevity risk and the Solvency II standard formula: a misaligned perspective

EU insurers are required to assess the appropriateness of the Solvency II Standard Formula (SII SF) for their portfolios. For longevity risk, this presents a challenge: the SII SF shock is calibrated using multi-year uncertainty, while the SCR is defined as a one-year Value-at-Risk of the Own Funds. This mismatch makes a proper appropriateness assessment impossible, calling for a revision of the longevity shock. Moreover, insurers would benefit from using more precise modelling techniques rather than relying on a fixed 20% shock.

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UNDERSTANDING THE SCR: SOLVENCY II'S RISK MEASURE

Article 101(3) of the Solvency II Directive defines the Solvency Capital Requirement (SCR) as the Value-at-Risk of an insurer's basic Own Funds over a one-year period, at a 99.5% confidence level. This means the SCR reflects potential changes in Own Funds due to adverse events within a one-year horizon. For longevity risk, the focus should therefore be on how changes in longevity assumptions or emerging experience over one year could impact Own Funds.

THE GENESIS OF THE SII SF LONGEVITY SHOCK

Before Solvency II's implementation, several Quantitative Impact Studies (QIS) informed the calibration of SCR shocks, though documentation was often incomplete. For example, the longevity shock was reduced from 25% in QIS4 to 20% in the final version, with little explanation.

Although the longevity shock is intended to capture trend, level, and volatility risk, its justification focuses solely on trend. The 2010 calibration paper[1] analysed cumulative improvement rates and simulated multi-year survival rates using unisex mortality data, while BE tables are typically sex-specific.

Cumulative improvement rates were calculated for 1992–1999, 1999–2006, and 1992–2006, reflecting historical changes rather than future uncertainty. If these trends are already embedded in BE assumptions, they do not represent additional longevity risk.

Survival simulations were conducted for different ages over durations from 5 to 30 years and for whole life. For each age-duration combination, the 99.5th percentile was reverse-engineered into an instantaneous shock to BE mortality rates, ignoring discounting effects. These simulations reflect multi-year uncertainty, not the one-year horizon required for SCR. Moreover, the implied shocks for key ages were closer to 10–15%, significantly lower than the 20% used.

In 2017, EIOPA consulted insurers on the calibration of longevity and mortality stresses. Insurers favoured a time-dependent longevity shock to better reflect the nature of the risk, but EIOPA retained a time-independent approach.

Interestingly, the Insurance Capital Standard (ICS), published in December 2024 by the IAIS (which includes DNB and other EU supervisors), sets the longevity shock at 17.5%, 2.5 percentage points lower than the SII SF shock, resulting in 12.5% lower capital requirements. Yet, the Solvency II 2020 review (concluded in 2025) left the shock unchanged, raising questions about consistency.

These observations cast doubt on the appropriateness of the SII SF longevity shock. Insurers may benefit from conducting their own assessments to better reflect the full spectrum of longevity risk.

THE RISKS IN LONGEVITY RISK

Quantifying longevity risk involves assessing multiple sources of uncertainty. Best Estimate (BE) forecasts are typically derived from stochastic mortality models. As outlined in the table below, different dimensions of longevity risk affect liability values and are explicitly referenced in Solvency II texts under SCR Longevity and SCR Mortality.

Risk modules	Risk sources
• **Level risk**: misestimation of current mortality levels in the insured population. • **Trend risk**: uncertainty in future mortality developments. • **Volatility risk**: impact of individual mortality variation on liability values.	• **Sampling risk**: variability in observed mortality despite known mortality rates. • **Process risk**: uncertainty in how mortality evolves over time. • **Parameter uncertainty**: uncertainty in model parameters estimated from historical data. • **Model risk**: differences in outcomes due to choice of mortality model.

The listed risk modules are commonly used in internal models and economic capital frameworks. Each module represents a category of factors that can influence current mortality expectations. Risk sources describe how deviations from assumptions may statistically manifest. A single module may be affected by multiple sources—for example, trend risk can stem from both process risk (uncertainty in future developments) and model risk (variability across projection models).

Trend risk is generally more material than level or volatility risk and should therefore be the primary focus when comparing SCR Longevity calibrations.

COMMON APPROACHES TO MODELLING LONGEVITY TREND RISK

Academics and practitioners have explored various methods to quantify longevity trend risk. These approaches differ primarily in the risk horizon considered:

- **One-year risk horizon**: Reflects potential changes in Own Funds over a single year, aligning with Solvency II requirements.
- **Multi-year risk horizon**: Captures uncertainty across the full projection period (i.e., runoff uncertainty) but is not suitable for Solvency II PIM or SF appropriateness assessments due to its mismatch with the one-year SCR definition.

A common one-year approach involves mimicking the assumption update process: using next year's mortality observation to recalibrate the BE model. This method reflects one-year risk horizon / multi-year uncertainty, as it models a random realization over one year but also its impact on future assumptions. It differs from one-year uncertainty approaches, which only shock next year's mortality rates.

Implementing a recalibration-based approach raises several complex questions. Below are practical observations from experience:

- **Recalibration window**: Shorter periods increase sensitivity to new data and raise capital; longer periods may understate risk. Linking the length of the window with portfolio duration can reduce reliance on expert judgment.
- **Scenario selection**: Mortality rates vary by age and sex, making the definition of a 1-in-200-year worst-case scenario non-trivial. Stochastic valuation helps identifying which scenarios drive capital requirements.
- **Model risk**: Solvency II requires undertakings to assess model risk. Different models yield different BE paths and uncertainty estimates—especially relevant for longevity trend. Scenario testing helps explore how shocks may materialize.
- **Basis risk**: Longevity shocks are based on population-wide data, which may not reflect insured populations. Comparing historical improvements between the general population and your portfolio can support the use of population trends.

Longevity risk is inherently long-term, making one-year SCR modelling challenging. Nonetheless, Solvency II mandates a one-year risk horizon. In practice, internal model-based SCR Longevity shocks are often lower than the SII SF shock, the latter reflecting multi-year risk horizon and lacking diversification between sexes.

CONCLUSION

There is no strong justification for the current 20% longevity stress in the Standard Formula. If most insurers find that internal model-based SCRs are significantly lower, it may be time to revisit this calibration. A more refined Standard Formula—one that better reflects how longevity risk affects liabilities—would be a welcome improvement. Duration-dependent shocks are already used for interest rate risk, so why not for longevity? ■

1 – CEIOPS. (2010, April 15). *Calibration paper: Solvency II*. Retrieved from https://register.eiopa.europa.eu/CEIOPS-Archive/Documents/Advices/CEIOPS-Calibration-paper-Solvency-II.pdf