

Calibration and Validation of ESGs

How to ask the right questions?

Introduction

Valuation of long term life insurance business remains a key topic of interest under various regulatory regimes (Solvency II, IFRS 17, ICS). For with-profit business covering guarantees in most cases scenario techniques are necessary to establish an appropriate valuation approach. Consequently the underlying Economic Scenario Generator (ESG), providing the risk neutral capital market scenarios, and its calibration is of main interest.

While the approach whether to “make” or “buy” software and in the latter case to autonomously calibrate the model at a specific valuation date or not, varies strongly between companies, all need to ensure a proper validation of the chosen valuation scenarios. This need is not only based on internal quality requirements but is more and more the focus of national supervisor authorities (NSAs).

The following best practice guidance shall provide actuaries with some background information on basic considerations, challenging questions linked to the current economic environment (e.g. negative interest rates) and recent audit approaches from NSAs. The leading principle is to enable the reader to ask the right questions to ensure a sound validation.

We structure the paper in the following way. In the first part we give recommendations on how to evaluate if a given scenario set can be seen being appropriate. In the second part we highlight hurdles to overcome and necessities of models to produce a scenario, in case a scenario set is produced in-house rather than bought from an external party. In the last part we mention some well known issues related to interest rate modelling.

Validation of risk-neutral scenarios

- Must have:
 - Passing martingale tests for a given confidence interval, e.g.:
 - Total Return Indices
 - Constant Maturity Indices
 - Bond Prices
 - ...
 - Replicating the basic reference rates (EIOPA RFR)
 - Replicating at least the most relevant volatility of interest rates (e.g. the 10/10 at-the-money swaption implied volatility)
 - Depending on which model is needed (depending on which asset classes are modeled):
 - Replicating spread curves (if stochastic spreads are modelled – **necessary(?)** if fixed income assets are within the portfolio)
 - Replicating the most relevant equity volatility (if equities are modelled), e.g. the 5 year at-the-money Eurostoxx50 implied volatility
 - Further necessities dependent on which stochastic variables are modelled, e.g. replicating volatilities needed for further indices, dividends, ...
 - Ensuring stability (convergence) of the modelled stochastic values as an output of the used Asset-Liability-Model (e.g. PVFP), by evaluating the sensitivity on the number of simulations within the scenario set
- Nice-to-haves:
 - Replicating a set of pre-defined interest volatilities, e.g. some points of the at-the-money swaption implied volatility surface
 - Replicating a set of pre-defined equity implied volatilities, e.g. for different expiries
 - Replicating specified correlations between modelled variables e.g. interest rates, equity indices, ...
- Very Nice-to-haves:
 - Replicating interest rate volatilities not used for calibration, e.g. not at-the-money swaption implied volatilities

Choice of risk-neutral models

The following points are not mandatory but should give a guidance on how to choose a model.

- Interest rate model
 - Replicating an arbitrary interest curve (e.g. allowance of negative interest rates)
 - Possibility of setting boundaries to the model (e.g. a lower bound for interest rates)
 - Replicating a set (more than one) of market interest rate volatilities
 - Replicating the correlation structure of interest rates
 - Trade off between model restrictions and degrees of freedom of used parameters, e.g. restricting to a functional form of interest rate volatilities or not
- Equity/Index model
 - Replicating a single or a set, depending on the complexity of the asset and availability of market data, of target volatilities
 - Replicating the pre-defined dividend
- Credit model
 - Replicating (market) spread curves for a number of ratings / spread classes
 - Replicating expected transitions (including defaults)
 - Replicating expected recovery rates in cases of defaults
 - Replicating dependencies between ratings
 - Controlling the volatility of spread movements
- Inflation / real rate model
 - Replicating an arbitrary inflation or real rate curve
 - Replicating target volatilities of inflation rates or real rates
- Dependencies
 - Replicating dependencies within a model, e.g. interest rates
 - Replicating dependencies between different models, e.g. equity and credit
- ...

Current known challenges of models

Here we want to mention some hurdles that are currently well known and some models have real problems overcoming these issues.

- Negative interest rates and boundaries on interest rates
- Log-normal (Black) versus normal swaption implied volatilities