



Banc Ceannais na hÉireann
Central Bank of Ireland

Eurosystem

2011

Discussion Paper: Economic Scenario Generators and Market Consistency



Table of Contents

1	Executive Summary.....	3
	1.1 Scope.....	3
	1.2 Review Process.....	3
2	Market Consistency and ESGs.....	4
3	Key Topics for Discussion.....	5
	3.1 Term Structure of Volatility and Implied Volatility Skew.....	5
	3.2 Through-the-cycle or point-in-time valuations.....	5
	3.3 Long term volatility assumptions.....	6
	3.4 Short term volatility assumptions.....	6
	3.5 Benchmarking of pricing methodologies to the Options market.....	7
	3.6 Allowance for non-hedgeable market risks and trading costs.....	7
4	Concluding Remarks.....	8
	4.1 Discussion Paper Responses.....	8
	4.2 Next Steps.....	8

1 *Executive Summary*

The forthcoming Solvency II Directive will require undertakings to value contracts, and options embedded in them, on a market consistent basis. In order to achieve market consistency, undertakings may use a large number of possible future economic scenarios to place a value on their insurance obligations. This is typically achieved by using Economic Scenario Generators (“ESG”s) which are calibrated to financial instruments in the capital markets which exhibit similar features to the insurance obligations. This requirement is relatively straightforward where undertakings can reference a deep and liquid market for such financial instruments but it is much more difficult to ensure market consistency where a deep and liquid market does not exist for these instruments. This is especially the case where undertakings provide contracts with long term investment guarantees. The market for financial instruments exhibiting similar features to the guarantees may not satisfy the criteria of being sufficiently deep and liquid beyond a 3-5 year horizon.

Some of these issues are discussed in more detail in a recent paper presented to the Society of Actuaries in Ireland by James Maher entitled, [“OTC Option Pricing for Insurers”](#).

This paper sets out some of the resulting difficulties in achieving market consistency for contracts with long term investment guarantees. The Central Bank regards this as a highly technical area which merits extensive debate and as a result, submissions are invited from interested parties on establishing a framework for best practice in this area.

1.1 Scope

The discussion paper is relevant to all insurance undertakings, regulated by the Central Bank, which are transacting material investment guarantee business, particularly variable annuity business. Submissions are also invited from other industry stakeholders or professional bodies.

1.2 Review Process

Submissions are invited during the period up to the end of June 2011. Submissions should be sent to variableannuities@centralbank.ie or by post to the Variable Annuity Examination Team, Retail Insurance Supervision, Central Bank of Ireland, PO Box No. 11517, North Wall Quay, Dublin 1.

2 *Market Consistency and ESGs*

A Market Consistent valuation of technical provisions is required by the Solvency II Directive. ESGs will be typically be used by undertakings in meeting this requirement. The Solvency Capital Requirement (“SCR”), whether based on the standard formula or internal model approach, is derived by examining the change in technical provisions in a number of scenarios. As a result, where the ESG is used to value technical provisions, it will also play a central role in the calculation of the SCR.

In using an ESG to determine the market consistent valuation of insurance obligations, it is critical that the ESG provides a good fit to market prices. This is more readily attainable where the market for the underlying financial instruments is deep and liquid. The options and guarantees provided by insurance companies sometimes share characteristics with those of frequently traded derivative instruments for which market prices can be observed. They may also contain features that cannot be calibrated to vanilla derivative instruments. As a result, the insurer may have sold an option that does not trade in the market, and for which a market price therefore cannot be directly observed. The same is also true when the term of the liabilities being valued is greater than the term for which market data is available.

It is clear from the above that using the ESG to value these complex options and guarantees requires significant judgement in the calibration of the ESG where market prices do not exist, or where the market lacks sufficient depth and liquidity. Extrapolation of market prices is necessary in such situations in order to calibrate the ESG. The manner in which such extrapolation is carried out requires careful consideration to ensure consistency with all available market data.

It is clear to the Central Bank that there is not a consensus on the treatment of key issues that arise in the calibration of ESGs. As a step towards establishing best practice in this area, the Central Bank invites submissions from interested stakeholders on the areas identified in Section 3.

3 *Key Topics for Discussion*

The following are areas where the Central Bank would like to see a greater consensus on methodologies to overcome the difficulties of achieving market consistent ESGs. It is acknowledged that the following issues can be interdependent upon one another.

3.1 Term Structure of Volatility and Implied Volatility Skew

ESG models using a relatively simple Black-Scholes model for equity returns may be able to reliably replicate option prices for at-the-money options, but this model does not reliably replicate the full volatility surface. The model may overstate prices of in-the-money options (with a strike price above 100%) and underestimate the prices of out-of-the-money options.

Some undertakings, in calibrating their ESGs to their individual portfolios, will identify the average moneyness of their liabilities and calibrate the ESG on that basis. However, it must be noted that such approaches may not be sufficient for all portfolios, if the equity option price is a convex function of moneyness.

More sophisticated models may be necessary to better capture the variation in the market volatility surface and therefore price a wider range of equity options more accurately. These models may capture market features such as equity volatility clustering (periods of high market volatility following each other), jumps in volatility or the so called volatility smile for interest rates.

Question 1:

As companies prepare for Solvency II when should undertakings consider the use of more sophisticated models which capture the features identified above?

Question 2:

Does the adoption of such models introduce other complications? If so, what are they and what approaches can be used to address these?

3.2 Though-the-cycle or point-in-time valuations

It was observed in the 2008 crisis that market implied volatilities spiked to very high levels. Would this mean that, in order to be market consistent, the options in insurance contracts have to be valued in a manner which reflects these rates? Alternatively, can a 'through-the-cycle' approach be used where the range of scenarios assumed will reflect an "average" position?

While this does avoid exacerbating pro-cyclicality in terms of capital requirements fluctuating with the state of the market, it would however be knowingly suppressing an actual point in time value in favour

of what might happen in a typical/average year. This is particularly true of market volatility but could equally apply to other factors.

Question 3:

Can 'through the cycle' calibrations ever be regarded as market consistent?

Question 4:

If so, under what circumstances and with what caveats?

3.3 Long term volatility assumptions

The assumption for long term volatility is a key determinant in the level of technical provisions for investment guarantee business. It is not clear to the Central Bank that there is a general market consensus on the methodology for the determination of the volatility assumption for long-term guarantees.

The methods currently adopted by industry participants range from the use of a relatively simplistic constant volatility assumption based on historical information, to market implied volatility or to the use of more sophisticated models such as GARCH. In the case of the GARCH model, the implied volatility at the last liquid data point is extrapolated to a long term ultimate rate. Methods may assume mean reversion to a long run average rate derived from historical data or auto-reversion or no term structure.

Question 5:

How should changes in volatility be modelled?

3.4 Short term volatility assumptions

From the perspective of the insurance undertaking, one can view the long term as simply being a series of short terms. This approach to analysing the long term volatility positions on insurers' balance sheets would suggest that it is the volatility implied by short term option prices, and its volatility that is more relevant to insurers than placing reliance on mean-reversion, or other relationships over the long term, particularly where this tends to reduce the apparent cost of provision of long term investment guarantees.

Question 6:

Does this mean that only short term volatility is important?

Question 7:

Does this mean that very short term (e.g. daily) fluctuations need modelling?

3.5 Benchmarking of pricing methodologies to the Options market

The options market, which is used as a reference point for volatility parameters when valuing liabilities, is relatively deep and liquid for terms of up to 5 years. Options for terms in excess of this are thinly traded and incorporate substantial liquidity premia into the price as the capital markets command an increasing premium with term to assume long term volatility risk. During periods of market stress, market liquidity may dry up completely, even at short durations.

In addition to the calibration of the ESG, the market is also directly relevant to undertakings where it forms part of a more balanced strategy to risk mitigation as opposed to full reliance on either a reinsurance or dynamic hedging solution.

Question 8:

How should the liquidity margins embedded in the market for option prices be reflected in the valuation of investment guarantees?

3.6 Allowance for non-hedgeable market risks and trading costs

Benchmarking the volatility parameters used in the Options market at long durations and the assumptions used by insurance companies in valuing a portfolio of options and guarantees reveals a disconnect in the approaches adopted by the two market participants. Part of this difference can be explained by the inclusion of a margin for non-hedgeable market risks and trading costs by participants in the options market.

The margin for trading costs needs to take into consideration a variety of (interlinking) factors:

- Use of hedge instruments with poorer liquidity and the implications for bid/offer spreads (total return or price indices for example);
- Interaction of the above on frequency of rebalancing and resulting hedge error in normal and dislocated markets;
- Liquidity of the underlying and resulting implications for repo cost; and
- Recognition of the credit risk embedded in interest rates.

Question 9:

How should other margins be reflected in ESG's?

4 *Concluding Remarks*

4.1 Discussion Paper Responses

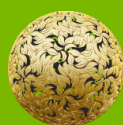
Submissions on the methodologies adopted to achieve market consistency in the calibration of ESGs are invited from all interested stakeholders.

All publications will be published unless requested otherwise. Submissions made for consideration requesting anonymity will only be considered where they contain clear propriety content.

4.2 Next Steps

It is clear to the Central Bank that there is not a consensus within industry on the treatment of key issues that arise in the calibration of ESGs for the valuation of contracts with long term investment guarantees. As a step towards establishing best practice in this area, the Central Bank invites submissions from interested stakeholders on the areas identified above. It should be noted that the Central Bank does not intend to introduce formal requirements for the approval of ESGs. Nor is it the intention to unilaterally impose standards for internal model approval. The Central Bank will however be seeking to lead and guide technical discussions within the Supervisory Community as it is acknowledged that the Central Bank has technical knowledge in this area.

T +353 1 224 4000 F +353 1 894 4631 www.centralbank.ie insurance@centralbank.ie



Banc Ceannais na hÉireann
Central Bank of Ireland

Eurosystem

**Bosca OP 11517, Duga Spencer, Baile Átha Cliath 1, Éire
PO. Box No 11517, Spencer Dock, Dublin 1, Ireland**

