Office of the Policyholder Advocate

Report Number 33 A

Modelling for the Purpose of the Reattribution

A summary of Aviva's proposals in connection with the reattribution of the inherited estates of CGNU Life and CULAC with-profits funds

Norwich Union rebranded as Aviva in the UK on 1 June 2009. Where an historical position or events prior to 1 June 2009 are described in this appendix, 'Aviva' and associated naming conventions have been used. Financial information has not been updated and remains as at the time of the report date.

Appendix by: Aviva UK Life – June 2009

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AVIVA

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1.00 Context

In formulating its reattribution proposals and offer Aviva has undertaken extensive stochastic modelling in order to assess the impact of a wide range of possible economic scenarios over the next 25 years.

This numerical analysis has been one of the factors taken into account in assessing the benefits of reattribution to both policyholders and shareholders, and in reaching our conclusions on the fairness of the Policyholder Incentive Payment (PIP) and the treatment of non-electing policyholders.

A large number of assumptions are made in order to assess the possible scenarios over the next 25 years. Inevitably unforeseen circumstance (both beneficial and detrimental) in the future can be different from the assumptions made. It is not possible to accurately predict what might happen over the next 25 years, the basis used by Aviva is felt to provide a balanced representation of possible 'real life' events that could take place in the future.

This appendix describes the stochastic model used by Aviva to produce the numerical analysis on which the company assessed the fairness of their offer to eligible policyholders in the reattribution of the CGNU Life and Commercial Union Life Assurance Company (CULAC) inherited estates. The modelling covered a wide range of possible economic scenarios over the next 25 years.

In particular this appendix focuses on the merits of stochastic and deterministic models. It does not however go into the detail of all of the calculations performed.

The appendix also reflects on the approach adopted by the Office of the Policyholder Advocate.

2.00 An Explanation of Stochastic Models

"Stochastic" means being or having a random variable.

A stochastic model is a tool for estimating probability distributions of potential outcomes by allowing for random variation in one or more inputs over time. The random variation is usually based on fluctuations observed in historical data for a selected period using standard time-series techniques.

Distributions of potential outcomes are derived from a large number of simulations (stochastic projections) which reflect the random variation in the input(s).

Its application initially started in physics. It is now being applied in life sciences and social sciences, and especially in finance.

2.01 Valuation

Like any other company, an insurer has to show that its assets exceed its liabilities to be solvent.

In the insurance industry, however, liabilities are not generally known with certainty. They depend on future economic experience, the impact of policy guarantees, policyholder actions, e.g. policy surrender and management actions, e.g. bonus rates.

So the valuation of the assets and liabilities of an insurer involves a set of projections, looking at what is expected to happen, and thus coming up with an assessment of the value of the assets and liabilities, and therefore for the company's level of solvency.

2.02 Deterministic Approach

The easiest way of doing this, and indeed the method which, historically, has been the primary one used, is to look at best estimates.

The projections should use the most likely investment return, the most likely bonus rates and so on. This creates a point estimate - the best single estimate of what the company's current solvency position is.

The downside of this approach is it ignores the fact that there are a number of different uncertainties in the estimates, and that a whole range of outcomes is possible. Having said this, deterministic models can be useful for developing an overall broad understanding of the current and likely future financial position of insurance funds.

2.03 Stochastic Modelling

A stochastic model would set up a projection model which looks at a single policy, an entire portfolio or an entire company. Rather than setting investment returns according to their most likely estimate, for example, the model uses random variations to look at what a range of investment conditions might be like.

Based on a set of random outcomes, the experience of the policy/portfolio/company is projected, and the outcome is noted. Then this is done again with a new set of random variables. In fact, this process is repeated thousands of times.

At the end, a distribution of outcomes is available which shows not only what is the most likely estimate, but also what ranges are reasonable.

This is useful when a policy or fund provides a guarantee, e.g. a minimum guaranteed maturity value. A deterministic simulation, with varying scenarios for future investment return, does not provide a good way of estimating the cost of providing this guarantee.

This is because it does not allow for the volatility of investment returns in each future time period or the chances that an extreme event in a particular time period leads to an investment return less than the guarantee.

Stochastic modelling builds volatility and variability (randomness) into the simulation and therefore provides a more accurate representation of real life.

2.04 The Asset Model

Although the text refers to "random variations", the stochastic model does not just use an arbitrary set of values. The asset model is based on detailed studies of how markets behave, looking at averages, variations, correlations, and more. The asset model is sometimes referred to as the Economic Scenario Generator (ESG).

The models and underlying parameters are chosen so that they fit historical economic data, and are expected to produce meaningful future projections.

A market consistent stochastic model is calibrated in line with market option prices, so that the valuation of liabilities with optionality in the fund is consistent with those observed market prices. This is different from the best estimate ESG outlined below.

3.00 Aviva Plc Economic Scenario Generator

Aviva Plc uses a (best estimate) Economic Scenario Generator (ESG) for Risk Based Capital (RBC) projections by its business units. This ESG also forms the basis for Aviva's numerical projections created for the CGNU Life and CULAC reattribution and fund transfer.

The ESG creates "real world" scenarios i.e. with a risk premium being earned by "risky" assets.

The ESG output is in the form of economic data for all asset classes. All material asset classes are modelled.

4.00 Modelling Methods used for the Reattribution and Fund Transfer

Aviva considers results determined on both a deterministic and stochastic basis. However, whilst the deterministic results are useful for providing insight and understanding of the current and likely future financial position of the funds, the effects of the asymmetrical distribution of future financial outcomes for the with-profits funds can only be properly assessed through the use of stochastic techniques.

For the reattribution and fund transfer, stochastic scenario tables are created for all the required Stochastic Variables (see below). The number of simulations used varies according to the purpose of the model and ranges from 1,000 to 20,000 simulations.

4.01 Stochastic Variables

The stochastic scenario table contains all the real world parameters for rolling up the assets and asset shares in the stochastic model. The following ESG outputs are used in the projection of the revenue items and the valuation of guarantee costs:

- Risk free rates
- Total return on cash
- Total return on UK equities
- Running yield on UK equities
- Total return on overseas equities
- Running yield on overseas equities
- Total return on property
- Running yield on property
- Gross redemption yield on Gilts
- Gross redemption yield on corporate bonds

Assets are rolled up using the total return indices. Running yields are used to split the return between income and capital gains for tax modelling purposes.

The total return on Gilts and Bonds is derived in the model by using the changes in the corresponding gross redemption yields over the year.

4.02 Liability Model

The liability model is used to provide projections that are consistent with each simulation of the asset model (ESG). The growth in policy values is derived from a stochastically generated dynamic model. The model determines the market consistent value of the cost of guarantees and capital requirements for the funds using closed form (i.e. option pricing based) solutions.

The term dynamic is used to describe a model that has built-in management decisions that reflect the discretion that the company has to change aspects of its fund management. For example, changes made to the underlying asset mix of assets backing policies and bonus rates.

The model Aviva uses is a dynamic model.

4.03 Dynamic Management Actions in the Stochastic Model

The stochastic financial projection systems contain dynamic management actions for the Equity Backing Ratio (EBR) of the assets backing asset shares and for the reversionary bonuses declared. These management actions are dynamic in that they reflect the circumstances of each simulation at each point in the simulation.

4.03.01 EBR Decision Maker

The EBR decision maker in the dynamic model reflects the "theoretical EBR" approach used in practice to manage the asset mix of asset shares. The theoretical EBR takes into account both the value of projected guarantees and the asset share and employs "dynamic hedging" methodology to determine the EBR for the assets backing asset shares.

In essence, the approach assumes that the with-profits policy liabilities can be matched by a combination of a zero coupon bond and a call option. Using option pricing theory, this notional asset backing can be reconstructed so that it can be expressed as a combination of fixed interest assets and equities, from which the theoretical EBR can be derived.

This means that when asset shares are closer to the value of guarantees then the extent to which reliance can be placed on equities is low and the resultant theoretical EBR is low. When asset shares increase further above the value of guarantees, the reliance that can be placed on equities is greater and a higher theoretical EBR results.

In practice, the theoretical EBR also reflects the size of the estate, with a larger estate supporting a higher EBR. Allowance for this is also made in the dynamic model.

The model also allows for the additional constraints on the asset share EBR that are to be introduced as a further policyholder safeguard after the reattribution.

4.03.02 De-risking the Cost of Guarantees

During 2007 Aviva implemented a new investment strategy for the assets backing the reserve for guarantees in CGNU Life and CULAC, the aim of which is to "de-risk" the cost of guarantees in relation to its exposure to variation in equity and property values. The stochastic model allows directly for the de-risking strategy, which is therefore modelled on a simulation specific basis.

4.03.03 Reversionary Bonus Decision Maker

The primary driver of the reversionary bonus decision maker is the objective of paying half to two thirds of the earned net-of-tax investment return as reversionary bonus, with the balance being paid as terminal bonus. The reversionary bonus algorithm therefore takes into account the following factors at each decision point in every simulation:

- Expected future net-of-tax investment earnings;
- The current value of asset shares in relation to projected guarantees; and
- The value of future premiums (if any).

Where past investment performance has been favourable, all other things being equal this will be partly reflected in a higher reversionary bonus rate. The higher the value of future premiums in relation to asset share, the more the reversionary bonus will be driven by the projected future investment returns, which in turn will primarily reflect simulated fixed interest yields.

Subject to some modelled smoothing rules, the model assumes that terminal bonuses are set so as pay out asset shares at exit (subject to any guarantees applicable).

4.03.04 Asset mix

In response to the continued market volatility the assumed asset mix for the inherited estate has been changed so that less is invested in equities. This short-term change in approach is as a direct consequence of the market volatility and is not considered to be a long-term change to the practices for managing the fund (as described in the Principles and Practices of Financial Management (PPFM)). As a consequence we would expect to return to using a similar asset mix for the pool of investments which back the inherited estate and the assets backing asset shares when markets and their volatility stabilise.

5.00 Review of Stochastic Modelling Methods used for the Reattribution and Fund Transfer

Aviva asked Tillinghast Towers Perrin (a major firm of consulting actuaries) to provide an opinion on the stochastic model used for the project. The work was performed in two stages, the first relating to the model as at the end of 2005 and the second relating to the model at the end of 2006, covering functionality included up to 2 October 2007.

Towers Perrin concluded overall that the model, allowing for certain specific adjustments to the results, was materially fit for the purpose described above. Towers Perrin’s opinion was provided solely for Aviva in accordance with the terms of Towers Perrin's engagement letter.

6.00 Assumptions within the the Reattribution and Fund Transfer Model

Full details of the assumptions used within the stochastic model have been shared with the Office of the Policyholder Advocate. Due to its price sensitive nature, it is not possible to document and share the detailed information of the assumptions used in this appendix.

7.00 Using a Deterministic Model to Value the Policyholder Incentive Payment

7.01 Background

The Policyholder Advocate used a deterministic model to assess whether or not the PIP is good value relative to the potential value of distributions that might arise in the future, and to determine how that assessment varies between different groups of policyholders.

7.02 The Model used by the Office of the Policyholder Advocate

The model used by the office of the Policyholder Advocate is a deterministic model in that it makes use of the 3 deterministic economic scenarios provided by Aviva, namely:

- Uniform best estimate returns throughout the projection;
- An optimistic "bull" scenario of uniform out performance of the best estimate returns; and
- A pessimistic "bear" scenario of uniform underperformance of the best estimate returns.

These projections were specified by the advisors to the Policyholder Advocate and prepared using Aviva's stochastic model (but run on a deterministic basis). It should be noted that this does not mean that the model used by the Office of the Policyholder Advocate is stochastic despite the fact that:

- the deterministic projections were performed using a model that is capable of performing stochastic projections (does not produce stochastic results)
- the deterministic model entails the use of closed form (option pricing based) estimates of future realistic liabilities and capital requirements

7.03 Stochastic versus Deterministic Approach

If the distribution of future outcomes were symmetrical, then the benefits of using a stochastic rather than a deterministic model might be limited. In these circumstances, the optimistic "best estimate plus x%" projection could vary by an equal (but opposite) amount from the best estimate result as the "best estimate minus x%" projection. This is likely to mean that the best estimate projection could be representative of the average of all of the stochastic projections.

This is not the case for the projection of potential distributions to policyholders, which are only payable when surplus exceeds the distribution threshold. In these circumstances, therefore, it is possible that a deterministic model will fail to capture the effects of the asymmetries that feature in the stochastic output.

This is not to say that deterministic projections are not useful or informative, rather they help to develop an alternative perspective of the financial position of the funds and how it varies in different circumstances. In addition, there is a possibility that, by chance, the best estimate result may not be materially different to the average result (particularly after allowing for de-risking and the special bonus). Nevertheless, the most accurate means of allowing for the asymmetrical distribution of outcomes when assessing the value of the PIP is to use a stochastic model.

8.00 Aviva’s view of the Policyholder Advocate’s Approach

In their paper the Office of the Policyholder Advocate has highlighted modelling and assumption differences between the bases used by Aviva and the Policyholder Advocate when assessing the possible value of the transaction for policyholders and shareholders.

Notwithstanding these modelling and assumption differences, the Office of the Policyholder Advocate and Aviva are satisfied that the offer is in the interests of the vast majority of policyholders when compared against a wide range of scenarios.

Aviva’s stochastic modelling of a wide range of possible economic scenarios over the next 25 years has led the company to conclude that the reattribution offer is good value for almost all eligible customers (99%), and represents excellent value for at least 95%.

- The offer is considered “good value” if a policyholder would have to wait at least 10 years before the estimated value of future distributions could exceed the offer
- The offer is considered “excellent value” if a policyholder would have to wait at least 25 years before the estimated value of future distributions could exceed the offer, or if the offer will always exceed the estimated future distribution.