Appendix 33 B

Modelling for the purposes of the reattribution

Reports for the policyholder advocate in connection

with the reattribution of the inherited estates

of the CGNU Life and CULAC with-profits funds

June 2009

Reports by : KPMG LLP and LECG Ltd

Contents

Office of the Policyholder Advocate

1.00 Introduction and Summary

1.01 Context

KPMG`s contribution to this appendix has been prepared for the policyholder advocate and is a response to Aviva's appendix 33 A on the same subject. Whilst KPMG has done its best within this appendix to explain technical terms and concepts, it remains the case that this is a technical report intended for readers who have some familiarity with the concepts involved.

In illustrating how the Aviva models work, KPMG has used very simplified examples. The detailed specifications of the models involved are beyond the scope of this appendix.

At several places within this report we make reference to reports produced by Towers Perrin. In each case we have made reference to the relevant report and, where we have set out the conclusion arising from that report, we confirm that we have had access to the report ourselves and have permission to respond to and/or summarise them. We also note that these reports contained detailed and considered wordings and opinions, and our summarisation of the key conclusions of these reports should not be regarded in any way as a substitute for any of the detailed wordings and opinions within those reports and is a not a substitute for reading them in full.

1.02 Background

Much of the basis of the negotiations between Aviva and the policyholder advocate were dependent on the valuation of the CGNU Life and CULAC with-profits funds' inherited estates, and on the forecast of possible future distributions from those inherited estates to policyholders and shareholders during the projected life of the with-profits funds. Various models were used by Aviva and the policyholder advocate to assess these values of these distributions.

1.03 Summary

This appendix sets out the key models used. KPMG has carried out certain high level review procedures on the Aviva models and believes the outputs of the various models to be reasonable for the purposes of the reattribution. KPMG has therefore relied on the output of several of the Aviva models in the context of reviewing and critiquing Aviva's valuations of the size of the inherited estates (see appendix 35 B) and Aviva's risk appetite and its assessment of its capital requirements (appendix 28 B). For the avoidance of doubt, it should be noted that KPMG has not carried out any detailed review or audit of any aspects of the Aviva models.

LECG, who are the modelling advisors to the policyholder advocate, used output in respect of one average scenario from one of Aviva's models (the Wagner[1] model) as an input into its model which has informed the policyholder advocate's negotiations with Aviva and the formulation of her guidance to policyholders.

Aviva's main criticism of the LECG modelling is that the approach uses one deterministic projection from Aviva's Wagner model as its key input in assessing the pattern of possible future distributions to policyholders and shareholders from the inherited estates, and that such a deterministic projection does not take account of the potential asymmetry in the pattern of future special distributions.

Outputs from stochastic models, such as Aviva's Wagner model, can be more difficult to interpret than output from deterministic models and it is more difficult to analyse different possible future scenarios due to the complex nature of such stochastic models and the time it takes to undertake different runs with different input assumptions. The policyholder advocate therefore used LECG's deterministic model (which used one scenario from the Wagner model) to forecast the pattern and scale of possible future distributions from the inherited estates under different assumptions. In particular, possible future distributions were evaluated, as to scale and timing, against different sizes of the inherited estates, and against different assumptions as to the levels of new with-profits business that might be written into the CGNU Life and CULAC with-profits funds.

However, the policyholder advocate acknowledged that the pattern of future distributions may be asymmetrical, and that this asymmetry would not be captured using the deterministic

[1] Wagner is the name given by Aviva to the reattribution project

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output from Aviva's Wagner model. The areas of asymmetry which were discussed with Aviva were:

- the cost of the guarantees (i.e. the policyholder benefits are protected from severe falls in the market);
- the potential impact on the amount and timing of releases of the inherited estates (an example of the impact on the amount would be as investment returns get higher, so do the releases of the inherited estate, however, no matter how low they get, the releases from the inherited estate cannot go below zero);
- the impact of discounting the future cash-flows at stochastic rates.

KPMG advised on the possible extent of asymmetry for the cost of guarantees which would not be captured in the deterministic data and due allowance was made for it in the LECG model outputs. This was done by taking account of the value of the inherited estates as adjusted by KPMG (which took account of the asymmetry) and ensuring that the present value of releases of the inherited estates from the LECG model was calibrated to this figure. KPMG also considered the potential impact of the other areas of asymmetry. Based on figures from Aviva which suggested that the impact of discounting stochastically rather than deterministically made less than £100m difference to the value of inherited estate distributions, and given that there was nothing to suggest that other areas of asymmetry could work against the policyholders' benefit, KPMG concluded that sufficient allowance was made in terms of asymmetry As Aviva acknowledges in its appendix, stochastic and deterministic modelling are complementary approaches. Moreover, both are aids to judgment rather than precise forecasting methods - see appendix 14 ("Approaches to modelling: stress testing, scenario analysis and stochastic modelling") for further explanation of the differences between the two modelling approaches and the inevitable limitations of any such forecasting methods.

1.04 Structure of this appendix

Section 2 to 4 inclusive of this appendix comprises of KPMG's report: Section 2 summarises the Aviva models relevant to the reattribution; section 3 outlines, without comment, Aviva`s position as set out in its appendix 33 A, and section 4 sets out KPMG`s views on Aviva`s models and position. Section 5 of this appendix comprises of LECG`s report. It describes the LECG model and summarises the main inputs to the model and the key outputs from the model. These outputs are subsequently discussed in considerable detail in appendices 37 to 46 inclusive.

Part I – KPMG's Report

2.00 Summary of the Aviva models relevant to the reattribution

2.01 Relevant Aviva models

The key areas of interest for the reattribution of the inherited estates are:

- the sizes of inherited estates (which are the differences between the values of the assets and the values of the liabilities);
- the estimated value of projections of potential special distributions from the inherited estates to policyholders and shareholders, and when they might take place, which inform the benefits forgone by policyholders electing to accept Aviva`s PIP offer;
- the estimated value to shareholders of the reattribution.

The five key Aviva models which have direct input into one or more of the areas mentioned above are outlined below. The first three (the ESG, the AS and the life DFA models) were key inputs into Aviva`s calculation of the value of the inherited estates. The Wagner model was used by Aviva to project possible future special distributions to policyholders and shareholders from the inherited estates. The EV model was used by Aviva to estimate shareholder value.

- The ***Economic Scenario Generator (ESG) model:*** This produces the stochastic economic scenarios used in the various other Aviva models which use stochastic methods to project forward cash-flows.

- The ***Asset Share (AS) model:*** This calculates the policyholders' asset shares. The asset shares form the largest part of the liabilities of the fund, thereby feeding directly into the value of the inherited estates.
- The ***Life Dynamic Financial Analysis*** (***DFA) model***: This is a stochastic model used to calculate the cost of options and guarantees which form part of the liabilities. This model was newly introduced in 2007, and replaced the 2006 RBS model which has now been used for additional checking purposes.
- The ***Wagner model***: This is a stochastic model used by Aviva to forecast possible future special distributions to policyholders and shareholders. Some of the outputs of this model are also used as inputs into LECG`s model, used by the policyholder advocate to inform her decisions.
- The ***Embedded Value (EV) model:*** This is used to value what the company is worth to shareholders in the supplementary information within the Aviva Group report and accounts.

In its appendix 33 A, Aviva only discusses the Wagner model. However, since the key inputs into this model were the sizes of the inherited estates, we have also covered the other models which were used to determine these inputs.

As discussed in appendix 35 B the "Size of the inherited estates", a key driver of the negotiations is the value of the inherited estates. Table 2.1 below is taken from that appendix and the last column illustrates which of the above models were used in determining the sizes of the inherited estates.

Table 2.1

CGNU Life and CULAC table of liabilities combined position

(£ millions) 31 December 2008	Total	Model
Regulatory value of the admissible assets of the fund	29,973	
- non-profit mathematical reserves	-2,968	
+ present value of profits on non-profit business (including release of LTICR)	832	
Total realistic assets	*27,837*	
Asset shares	19,715	AS
+ Planned enhancements	1,135	
- Planned deductions	-123	DFA
+ Contractual guarantees & guaranteed minimum pensions	2,244	DFA
+ non-Contractual guarantees (mortgage endowment promise)	440	DFA
+ Financial options	230	DFA
+ Smoothing costs	-43	DFA
+ Other long-term insurance liabilities (includes shareholder transfers)	46	DFA
+ Realistic current liabilities	2,665	
Total realistic liabilities	*26,309*	
Excess realistic assets (i.e. the estate)	*1,529*	

Source: FSA returns Forms 18 & 19 2007, Aviva RBS report 06/08 and 12/08– figures are subject to rounding

2.02 Brief description of the relevant models

We briefly describe each of the models below:

Economic Scenario Generator (ESG) model

Inputs

Inputs into this model are more complicated than for the other models as (for the market-consistent version) they need to include variables which are used to calibrate the mathematical formulae to ensure the output fits the market data. Some key inputs are market volatilities, yield curves and correlation assumptions. The inputs are set such that the best fit to the required output is achieved.

Calculations

The model uses mathematical formulae and random variables, along with the inputs to project forward a consistent set of asset return scenarios.

Outputs

Outputs of the model are thousands of projected scenarios for the financial parameters used in other models, such as inflation, equity and property returns, and risk free interest – described in more detail in section 4.01 of Aviva's report (appendix 33 A). These economic projections are then used as inputs into the DFA, the Wagner and to some degree the EV models.

Outputs from this model are broadly of two types: "market consistent", and "real world". Detailed explanations of these outputs are beyond the scope of this appendix but, simply speaking, market consistent outputs are required to be consistent with prices of various assets observed in the market, and all assets are on average expected to earn a rate consistent with the return on risk-free assets such as government bonds or swap rates. For real world output, equities, property and corporate bonds are expected on average to outperform risk-free rates. The excess return assumed on equities over the risk-free rate is referred to as the equity risk premium, and the volatilities, or fluctuations, may be different from market consistent volatilities, as they reflect a more long term view than a market view which tends to change more frequently. Typically the long term volatilities and the amount by which equities, property and corporate bond yields are expected to exceed risk-free rates on average are based on the behaviour of historical economic data.

Asset Share (AS) Model

Inputs

The inputs into this model are policyholder data (e.g. premiums, date of policy entry, date of birth, sum assured), and historic data, (e.g. expenses, investment returns, tax, cost of life cover). In this respect the inputs are factual or are estimates of what has occurred, as opposed to being estimates of what may occur in the future.

Calculations

The model effectively looks back to each policy start date, and accumulates all the cash flows relevant to the asset shares (e.g. premiums, expenses, investment returns) to determine the current asset shares.

Outputs

The outputs of the model are the policyholders' asset shares as at the date of the valuation. These asset shares, which may be grouped, feed into the realistic balance sheet (RBS) and also form the starting position for the DFA, EV and Wagner models.

Life Dynamic Financial Analysis (DFA) model

Inputs

The inputs to this model are, broadly: the summarised policyholder data, including asset shares from the AS model, economic scenarios based on a market consistent basis derived from the ESG model, plus other assumptions such as expected future expenses, bonuses, rates of deaths and surrenders.

Calculations

This model calculates the cost of guarantees for the liabilities which form part of the realistic liabilities in the FSA returns. Broadly, the model takes market consistent stochastic investment returns (output from the ESG model) as an input and projects forward the expected future asset shares and derived policyholder payouts, allowing for expected future bonus additions and guarantees. The model has dynamic management actions for investment strategy and bonus additions that respond to the economic conditions and projected financial position of the funds in each simulation. Payouts are based on the higher of the asset share and guaranteed minimum payout. Where the payout is higher than the asset share due to options or guarantees (rather than due to smoothing), the excess of the former over the latter is taken into account as an additional liability on top of the liability held for the asset share.

Outputs

The outputs of this model are thousands of scenarios for the present value of the cost of guarantees and options for the liabilities and the average of all the scenarios forms the final output of the realistic liabilities in the FSA returns. Other outputs of the model are certain other liability values which are needed for the FSA returns, such as the value of future shareholder transfers and the expected future cost of smoothing – these liabilities also being based on the average across all the scenarios.

These areas cover the liabilities in the FSA returns which in turn feed into the RBS which effectively places a value on the inherited estates.

Wagner Model

Inputs

The inputs to this model are basically the same as those for the DFA model, except that the economic inputs are based on a real world basis (sometimes termed "best estimate") as opposed to a market consistent basis. One other significant difference is that, in addition to current policyholder data, volumes of expected future new business are an input into this model.

Calculations

Broadly, the model takes real world stochastic investment returns (output from the ESG model) as an input and projects forward the expected future assets and liabilities along with all cash-flows to and from the fund. A key difference between this model and the life DFA model is that the Wagner model also projects future capital requirements which are required to determine projected distributions from the inherited estates.

Outputs

The outputs of this model are thousands of scenarios of projected future cash flows and balance sheet items. Some key outputs include:

- Possible future distributions of the estate to policyholders and shareholders under both the pre and post-reattribution scenarios. The distributions from this model are based on the published value of the inherited estate, but may not in aggregate equal the published value of the estate if the assumptions underlying the projections differ from those used in the RBS;

- projected asset shares;
- projected liabilities;
- projected AA and AAA capital requirements;
- projected assets.

The present values of the projected liabilities/outflows for all the scenarios are put in order of size, and are used by Aviva to identify the capital requirements needed to meet its risk appetite capital requirements (see "Policyholders` future security and risk appetite" in appendix 28 B for further details) at the valuation date. It is this calculation which helps to determine whether there is surplus in the inherited estate that can be distributed. Such a calculation was made prior to Aviva`s announcement of the pre-reattribution distribution.

The stochastic output from the Wagner model was used by Aviva to inform its negotiations, particularly in terms of the possible value to shareholders and the potential policyholder benefits forgone in the form of future special distributions.

Aviva produced output in respect of one average scenario from the Wagner model for LECG to use as an input into its model.

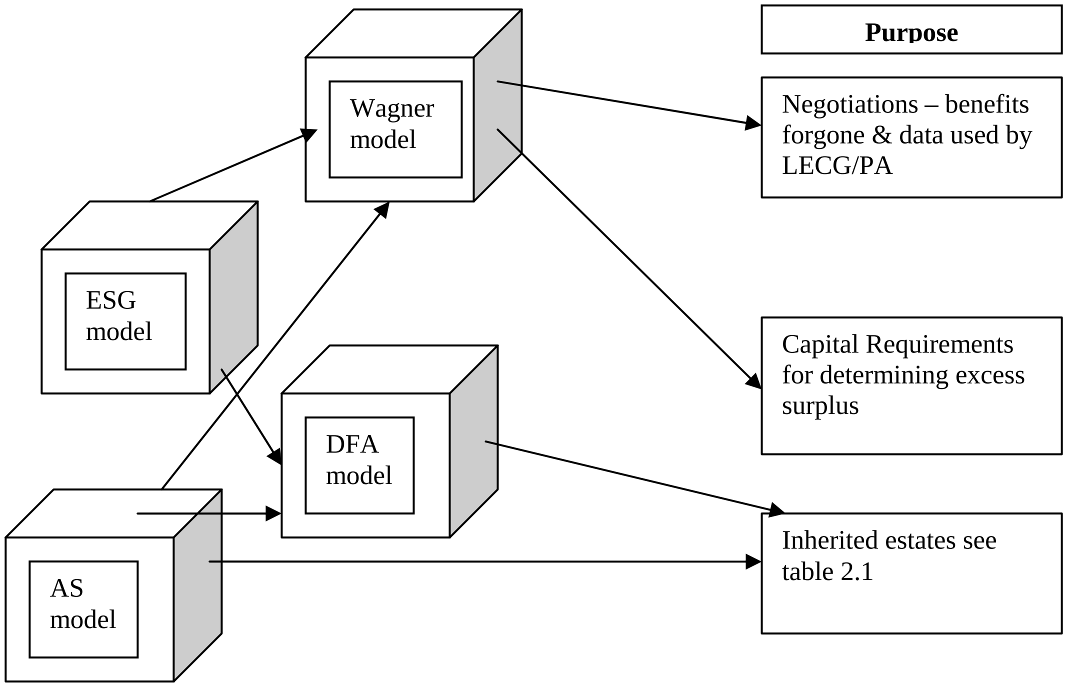
Embedded Value (EV) Model

The embedded value model is used to place a shareholder value on the CGNU Life and CULAC with-profits funds, and excludes the value of any expected future new business. The embedded value is equal to the sum of the value to shareholders of the existing business (i.e. the future shareholder transfers that are paid when bonuses to policyholders are declared) plus the value of the estate to shareholders less the value of options and guarantees not already included in the asset share liabilities, plus the market value of shareholder assets held in shareholders' funds.

The reason KPMG is interested in the EV model is because the results provide a high level check on other models, and also because we wish to ensure that the assumptions used by Aviva in the reattribution are consistent with those they used for the EV. This is because the EV is used by the company to place a value on its business, and any differences should be understood. The EV model is a well established model which will have undergone various reviews and is used by Aviva to check the reliability of output from the Wagner model.

Interactions between models which directly fed into the reattribution negotiations

We have illustrated below how the outputs from the various models discussed above are used as inputs into other models, and for what purpose they are used.



3.00 Outline of Aviva's appendix on its approach to modelling

3.01 An Explanation of Stochastic and Deterministic Models

In its appendix 33A "Modelling for the purpose of the reattribution", Aviva sets out an explanation of what both stochastic and deterministic modelling mean, and in which circumstances it is appropriate to use either of these approaches. Aviva states that stochastic modelling is useful when a policy or fund provides a guarantee (e.g. a minimum guaranteed maturity value). This is because the deterministic method 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.

3.02 Aviva Plc Economic Scenario Generator

Aviva states that Aviva Plc uses a (best estimate) ESG for Risk Based Capital (RBC) projections by its business units. This ESG also forms the basis for Aviva's numerical projections created for project Wagner. The ESG creates real world scenarios (i.e. with a return above risk free rates being assumed to be earned by "risky" assets).

3.03 Modelling Methods used for Project Wagner

Aviva states that it gives consideration to results determined on both a deterministic and a stochastic basis. However, Aviva states that, 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-profit funds can only be properly assessed through the use of stochastic techniques.

Aviva's stochastic financial projection systems contain management actions for the equity backing ratio (EBR) of the assets backing asset shares and for bonuses declared. These management actions are dynamic in that they reflect the circumstances of each simulation at each point in the simulation.

In practice, the approach to determining the EBR means that, when asset shares are close to the value of guarantees, then the theoretical EBR (see appendix 17 B "The Actuarial Function Holder's report" for more details) 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.

Aviva states that the stochastic model allows directly for its recently implemented de-risking strategy.

The primary driver of the reversionary bonus decision maker is the objective of paying half to two thirds of the earned net-of-tax (where appropriate) investment return as reversionary bonus, with the balance being paid as terminal bonus (otherwise know as final bonus). Where past investment performance has been favourable, this will be, all other things being equal, partly reflected in a higher reversionary bonus rate.

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

Aviva states that 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 PPFM).

3.04 Opinion on Stochastic Modelling Methods used for Project Wagner

Aviva asked Towers Perrin (a 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's work considered the ability of the model to project the realistic basis balance sheet assets and liabilities for the combined funds of CULAC and CGNU, and to derive the initial AAA threshold capital requirement.

Their work addressed the following:

- Modelling approach (including the modelling of the de-risking strategy)
- Model validations
- Independent spreadsheet checks on the reasonableness of the results

As agreed with Aviva, Towers Perrin did not consider the capability of the model to project the AAA threshold capital requirements of the funds, the scope of Towers Perrin's review excluded certain items (including the economic scenario generator used) and the review was performed to a specified level of materiality. In addition, Towers Perrin's opinion was conditional on the appropriateness of certain assumptions provided by Aviva as to the basis of operation of the model, and Towers Perrin relied on other data and information provided by Aviva without independent verification,

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.

3.05 Using a Deterministic Model to Value the Policyholder Incentive Payment

Aviva points out that the policyholder advocate used a deterministic model to assess whether or not the policyholder incentive payment (PIP) is good value relative to the potential value of special distributions that might arise in the future, and to determine how that assessment varies between different groups of policyholders.

Aviva states that, if the distribution of future outcomes was 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.

Aviva's view is that this is not the case for the projection of potential special distributions to policyholders, which are only modelled as being payable when surplus exceeds Aviva`s distribution threshold (105% AAA used in the model for Wagner calculations – see appendix 28 B, "Policyholders' future security and risk appetite" for more details on the distribution thresholds). In these circumstances, therefore, it is possible that a deterministic model will fail to capture the effects of the asymmetries that are observed in the stochastic output.

Aviva states that 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 that position varies in different circumstances. In addition, there is a possibility that, by chance, the best estimate result may not be materially different from the average of the results generated stochastically (particularly after allowing for Aviva`s recent de-risking and its special pre-reattribution distribution).

Aviva concludes that, 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.

4.00 KPMG's response to Aviva's paper

4.01 An Explanation of Stochastic Models

KPMG agrees with Aviva's assertion that stochastic modelling is useful when a policy or fund provides a guarantee, and agrees with its reasoning. KPMG also agrees with Aviva that stochastic and deterministic models are complementary approaches. As appendix 14 explains, both methods are aids to judgment, rather than precise forecasting tools.

4.02 Aviva Plc Economic Scenario Generator

Aviva's use of the ESG is in line with industry practice. The ESG used is the "Barrie and Hibbert" ESG, which is now used by a number of UK life insurance companies.

4.03 Modelling Methods used by Aviva for Project Wagner

The methods used by Aviva are generally in line with industry practice and, if anything, they are towards the more developed end of the range of practices within the industry. We consider further the assumptions used for the RBS in the "Size of the inherited estates" (appendix 35 B), and the assumptions used to determine the risk appetite in "Policyholders` future security and risk appetite" (appendix 28 B).

4.04 KPMG`s Review of Aviva`s Stochastic Modelling Methods used for Project Wagner

In its appendix, Aviva discusses only its Wagner model used for projecting possible distributions from the inherited estates over time. This section primarily responds to Aviva's comments on the reviews performed on the Wagner model. However, we begin with brief reviews of the other Aviva models relevant to the reattribution.

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ESG model

The form and calibration of the economic scenarios did not form part of the Towers Perrin review because unlike the Wagner model it was not a new model built for the purpose of the reattribution. The model can produce both market-consistent and real world output, and we note that the market consistent output from this model (which is used as an input into the DFA model), is used to produce results that are subject to external independent audit, and that the output requirements for the stochastic model use the same model but with different inputs.

We requested and were given access to the real world calibration documents which set out the detail of the assumptions, for example the risk free rates, volatilities and equity risk premium. The relevant data used for the reattribution was the 2006 ESG output. Aviva's calibration document comments that the 3% equity risk premium assumed is at the lower end justifiable by academic research. This could lead Aviva to understate the policyholders' possible future distributions from the estates, because higher equity risk premiums would result in higher returns on average. This is particularly true since Aviva admitted in their calibration report that the equity volatility assumption of 20% was probably on the high side for the period in question. However we agree that 3% is a reasonable allowance for the equity risk premium and, given the market turmoil which occurred in 2008, where market implied volatilities were closer to 30% at the end of December 2008, Aviva could well argue that their long term view of 20% may be understated.

Asset Share model

We have not reviewed this model. The output from the Asset share model feeds into the with-profit benefit reserve within the published Form 19 realistic balance sheet in the FSA returns. We note that the realistic balance sheet on Form 19 is one of the forms within the FSA returns which is subject to examination and opinion by the external auditors in accordance with requirements laid down by the FSA.

DFA model

We have not reviewed this model which was used for the first time in 2007. As discussed in the "Size of the inherited estates" (appendix 35 B) we are concerned with any areas which may lead this model to overstate the liabilities it produces, because the release of any such overstatement over time where it is not needed to meet policyholder guarantees will be released to shareholders.

The output from the DFA model feeds into the value of guaranteed benefits and financial options within the published Form 19 realistic balance sheet in the FSA returns. The realistic balance sheets as at 31 December 2008 and 31 December 2007 are based on output from the DFA model in this way. We note that the realistic balance sheet on Form 19 is one of the forms within the FSA returns which is subject to examination and opinion by the external auditors in accordance with requirements laid down by the FSA.

Aviva has provided a reconciliation between the model used for the 2006 RBS and new "life DFA" model (used from end 2007, and referred to above as the DFA model), and we note that improvements were made to the model which meant there were fewer areas of inherent prudence within the model used for the RBS compared with the previous year. The data used by LECG to inform the policyholder advocate is based on the year end 2006 and so is required to be consistent with the 2006 RBS. However, where the new RBS model has highlighted areas of differences, KPMG has taken these into account in the LECG projections by adjusting the starting value of the inherited estates used by LECG in its model. In particular, the data has been adjusted to allow for the reported value of the inherited estate as at December 2008.

Wagner model

Towers Perrin assisted Aviva with the development of the Wagner model and, as noted in Section 3.04, provided Aviva with an opinion that the model was materially "fit for purpose" with regard to the projection of the balance sheet assets and liabilities of the combined CGNU and CULAC funds, and the calculation of the initial AAA threshold capital requirement. We note that some specific high level adjustments outside the model were necessary due to the complex nature of the calculations.

However the scope of the “fitness for purpose” opinion was limited and, in particular, although the initial capital requirements (such as the AAA threshold) had been covered, the projected capital requirements had not, and it is those requirements that drive both policyholder and shareholder distributions from the estate and therefore drives the value of the policyholder benefits forgone.

It was therefore agreed with Aviva that KPMG would consider some further testing to be performed by Aviva to gain comfort that the projected capital requirements were not materially misstated.

We would note here that the various checks performed did highlight some deficiencies in the model which Aviva rectified with adjustments to the outputs.

We asked Aviva to compare a selection of projected capital requirements from the Wagner model with those which the model would produce if it were to calculate the capital requirements accurately as opposed to using approximations for the projections.

Based on the results produced, we concurred that the estimated projected capital requirements were a reasonable fit to the more accurately calculated values from the same model, and we asked for some further runs to be performed using a single more extreme stress. Although the fit was not perfect, we agreed that the differences were not material.

We noted that the capital requirements could be split into two parts, one part for the with-profits business and one for the non-profit business. In order to gain a fuller understanding of the fit, we asked Aviva to provide this split. Aviva concluded that the estimates tended to understate the with-profits capital requirement and overstate the requirement for non-profit and other risks such that the overall projection was reasonable. We concurred that the understatement of the with-profits component appeared to offset the difference.

The key point to note is that, overall, the model both over and understated the capital requirements for different stress tests, with a higher stress actually showing fewer differences, and the largest over statement being £126m. In summary, we were therefore comfortable that the results we were using were not materially misstated.

Reconciliations between models

Aviva uses different models to produce the various outputs, and uses these outputs from the models as a further high level check on the results. This is considered further below:

Stochastic projection model and embedded value model – As part of its work, Towers Perrin carried out a number of checks to compare the projected cash flows and surpluses under the Wagner model with those from the Embedded Value model, with both models set up to use the same assumptions. Towers Perrin concluded that overall the validation was reasonable although it noted that there were differences at a detail level between the two models.

Consistency between Life DFA and the Wagner model – Our expectation would be that, if the Wagner model were projected using the same assumptions as the Life DFA model, the two models should produce similar results for the value of the estate. Constraints on Aviva's time have not allowed them to do this comparison. However a comparison was done against the 2006 RBS, and Aviva has performed reconciliations between the 2006 RBS model and the Life DFA model.

The results of the comparison of the Wagner model with the 2006 RBS model showed some differences in the value of the estate which, when considered in terms of the size of assets and liabilities, are not material. However we felt that the differences were too large to be ignored when considering the impact on the value of the inherited estates. In addition, the levels of prudence which were identified in appendix 35 B ("Size of the inherited estates") were not allowed for in the stochastic model. The fact that the data was clearly out of date at the time it was being used meant that the output from the Wagner model needed some adjustments. Therefore, the projected special distributions which were output from the Wagner model and used by LECG were adjusted by LECG such that the present value of these distributions were equal to the value of the inherited estates of CGNU Life and CULAC (including the margins for prudence identified).

4.05 Using a Deterministic Model to Value the Policyholder Incentive Payment

KPMG acknowledged that both the guarantees payable on payouts and the pattern of future special distributions were likely to be asymmetrical. We therefore agreed to allow for the impact of such asymmetry where necessary.

First, an adjustment was made to the deterministic data provided by Aviva such that the value of the total future distributions (to all policyholders, both existing and new, and shareholders) plus any leakage from the estate such as tax and expenses of managing the inherited estates, equalled the inherited estates as adjusted in the "Size of the inherited estates" (appendix 35 B). We believe that any asymmetry in the guarantees is therefore, in aggregate, allowed for. This is because the inherited estates were based on a value of guarantees and options valued using stochastic modelling.

Second, we considered whether there was further asymmetry in the results which meant that, even if the deterministic model gave the correct value of the distributions of the inherited estate in aggregate, it might still serve to accelerate/delay distributions which in turn would increase/decrease the expected value of benefits forgone for the existing policyholders, thereby invalidating the comparison with the PIP being offered. After some investigation there was no evidence to suggest any particular bias in either direction.

In summary, LECG has implicitly allowed for the asymmetry of the cost of guarantees by calibrating the LECG model to the value of the inherited estates, but we have not allowed for any potential asymmetry in either direction in the pattern of distributions nor in the discounting of these distributions. We would note that we have allowed a deduction from the inherited estates (see appendix 37 B "Valuation of the Reattributed Estates"), which is a high level adjustment to allow for non-market risk. KPMG believes that the allowance should be adequate to cover all non-hedgeable risk, including any asymmetry risk not already covered.

Part II – LECG's Report

5.00 The LECG Models

The over-riding objective of LECG`s modelling work, in the context of Aviva`s proposed reattribution, is to inform the policyholder advocate's position by providing quantitative analysis of:

- the split of aggregate benefits between policyholders and shareholders;
- the allocation of policyholder benefits between groups of policyholders; and
- the impact of Aviva's proposals on groups of (electing and non-electing) policyholders.

The model inputs are a series of projected balance sheet and revenue account items which LECG requested from Aviva and based on specified scenarios. This data is remodelled and produces, as outputs, cash flows accruing to various groups of policyholders and shareholders which are expressed in present value terms.

As part of its analysis, LECG has developed two financial models: one to assess the potential future special distributions to policyholders and shareholders from the inherited estates (the fund-level model) and one to assess the policyholder incentive payment (PIP) offer made by Aviva on individual policyholders (the policyholder model). These models are discussed in turn below.

5.01 The LECG fund-level model

The LECG fund-level model was based on data which LECG requested be provided by Aviva and includes the functionality to vary assumptions in a number of different areas that affect the potential future distributions from the estates. The model has two base scenarios, one including only existing with-profits business and one which allows for new with-profits business. The data which allows for new with-profits business is based on Aviva's forecasts. These forecasts are discussed further in appendix 38 B ("Aviva's new business assumptions").

The model takes the liability and asset data corresponding to the base scenarios and applies various adjustments to reflect different assumptions. These adjustments are described further below. First, however we describe the inputs to the fund-level model.

Inputs

As described in Section 2.00 above, the underlying data for the LECG model comes from Aviva. The data used by LECG is a deterministic extract from the Aviva Wagner model. Each of the approximately 1 million Aviva policyholders is allocated to one of 160 existing business policyholder groups defined by combinations of product type, duration in force and outstanding term. The 10 product types used are as follows:

- CGNU conventional WP life;
- CULAC conventional WP life;
- CGNU conventional WP pensions;
- CULAC conventional WP pensions;
- CGNU unitised WP life;
- CULAC unitised WP life;
- CGNU unitised WP pensions – stakeholder;
- CGNU unitised WP pensions trustee bonds;
- CGNU unitised WP pensions – other;
- CULAC unitised WP pensions.

Policies within each product type are then categorised into one of 16 duration in force / outstanding term sub-groups based on the following sub-divisions:

- 0-5 years
- 6-10 years
- 11-15 years

- 16-25 years

Therefore in total there are 160 existing business policyholder groups (10 products x 4 duration-in-force categories x 4 outstanding term categories = 160 policyholder groups). New life and pensions business are treated as additional groups, giving 162 in total.

For each of the policyholder groups and base scenarios Aviva has supplied annual asset and liability data and other relevant information. The base asset data for each scenario consists of the following:

- market value of assets by asset class;
- net return on each asset class;
- capital requirement floor and ceiling; and
- excess surplus distributions (assuming no pre-reattribution distribution).

The base liability data for each of the scenarios consists of the following:

- numbers of policies;
- closing asset share and detail of annual movements;
- closing guaranteed benefits and claims paid;
- regular benefit details;
- expenses charged to asset share details;
- shareholder transfers;
- total liabilities, other liabilities (for both derisked and risked scenarios); and
- shareholder tax paid.

Calculations

The LECG fund-level model is designed to project and value the cash flows to shareholders and to each of the existing business and new business policyholder groups under a range of scenarios defined by scenario assumptions, such as:

- whether there is a reattribution;
- the amount and timing of any pre-reattribution distribution;
- the aggregate PIP offered by Aviva;
- shareholder tax rate;
- the future capital requirements of the fund; and
- the future levels of new business.

The LECG fund-level model also includes adjustments to the size of the inherited estates. These adjustments reflect the work performed by KPMG (see appendix 35 B "Size of the inherited estates") and are designed to:

- remove perceived excessive prudence from reserves;
- reflect asymmetries in the cost of guarantees not captured in the deterministic dataset; and
- reflect the size of the inherited estates based on market performance in 2007 and 2008.

After applying these adjustments, the LECG model forecasts possible future special distributions to policyholders and shareholders from the inherited estates that are consistent with the size of the estates as shown in Table 2.1 above (section 2.02). With the required scenario adjustments set, the LECG model then projects the cash flows from the estates to shareholders and policyholders.

Outputs

As described above, the LECG model projects and values the cash flows to shareholders and the different categories of existing and new policyholders. The main outputs from the fund-level model are:

- the value of possible future special distributions from the inherited estates to policyholders if no reattribution occurs;

- the possible cash flows to shareholders if no reattribution occurs; and
- the possible cash flows to shareholders in the event of a reattribution.

The policyholder group outputs for potential future special distributions are extracted for use in the policyholder model.

Testing of the LECG model

The fund level model has been subject to continuous and rigorous testing throughout its development and deployment. The testing procedures and techniques can be grouped into three areas:

- tests on the base data used by the model;
- tests on the model calculations; and
- tests on the model output.

Details of the testing procedures used in each of these areas are described below.

The base data used by the fund-level model has been checked by LECG for consistency and reasonableness. Any queries with the data were raised with Aviva and resolved either through written responses from Aviva or amendments by Aviva to the dataset.

The calculations within the LECG fund-level model were tested extensively. This process involved:

- Continuous testing by model developer;
- Automated checks within the model on accuracy of data entry into fund model;
- Calculation consistency checks built into the model itself;
- Calculation review by people other than the developer; and
- Parallel calculations performed separately from model and compared.

Any issues identified during this process were raised with the model developer and resolved.

The outputs from the LECG fund-level model were also tested. LECG has performed reconciliations between different scenarios to test the various adjustments that the model applies to the Aviva base data. LECG has also performed reasonableness checks on all outputs. Any issues arising during this part of the testing process were raised with either Aviva or the model developer and resolved.

Aviva originally requested an independent audit of the LECG fund-level model to ensure that information being provided to eligible policyholders was sufficiently accurate. However as outputs of the model became available for comparison during the negotiations it became possible for Aviva to identify any issues and ensure that they were dealt with. Aviva therefore felt that it would be unproductive to delay the project further by insisting on an independent audit when in all likelihood any errors found were unlikely to be material to the outcome of the negotiations or guidance being given to policyholders. Aviva therefore retracted its request for a formal audit.

5.02 The LECG policyholder model

The second model built by LECG, is based on data supplied by Aviva (following a request from LECG) about individual policies that were eligible for the reattribution as at 19 November 2007. The data has been used for formulating guidance to groups of policyholders, based on the comparison of potential future special distributions that the policyholders might receive in the absence of the reattribution with the individual PIP offered by Aviva. It has also been used to assess the position of non-electing policyholders under a reattribution.

Inputs

At the date of the data extract, there were 999,597 policies that were eligible for the reattribution. The data provided by Aviva contained, for each policy record, a unique identifier for the policy, the fund in which the policy was written, the type of policy, the maturity date of policy (if known), the start date of policy and a proxy for the realistic liabilities of each policy at 21 November 2006 ("the PIP Liability"), the date of the policyholder advocate's appointment.[2]

The data set is effectively divided into two large groups of policies. The first group is policies with a known expected maturity date. The second is policies that may be surrendered at the discretion of the policyholder and which are therefore without a known expected maturity date.

Aviva`s methodology for allocating the aggregate PIP between policyholders was then applied to all policies and compared to possible future special distributions forgone on the basis of the maturity dates, surrender dates or lapse dates of individual policies.

For purposes of assessing the allocation methodology, LECG has analysed the effect of the mechanism on particular groups of policyholders by using a random number generator to make the run-off profile of policies match the aggregate profile assumed in the fund-level model using data supplied by Aviva. The random number generator was used to set a "lapse date" randomly to policies whether they had a known expected maturity date or not. In every year, a proportion of policies lapse before their expected maturity date.

The basis of the data in the policy-level model differs from that in the fund-level model in the following respects:

- The policy-level extract is based on eligible policies at 19 November 2007, rather than eligible polices at 21 November 2006;
- There are, therefore, fewer policies in the policy-level data set than in the original fund-level data set. There are, however, more eligible policies in the policy-level data set in November 2007 than was projected in the fund-level data. We understand that this is a function of policies leaving the funds in the fund-level data but remaining eligible for the reattribution under the terms of reattribution scheme; and

[2] The PIP Liability is calculated by means of a formula which uses the sum assured and reversionary bonus (or their equivalent) attaching to a policy and is intended to approximate to the larger of the policy's asset share or minimum guaranteed value.

- Realistic liabilities of the eligible policies in the policy-level data are slightly lower than projected in the fund-level data because the projected investment returns in 2007 were higher in the model than they were in reality.

Calculations

LECG has adjusted the policy-level data in the model in the following ways:

- The PIP liability in the Aviva data has been adjusted to reflect the weightings to be used in the reattribution scheme;
- Each policy has been assigned a category that corresponds to the categories given in the fund-level data by Aviva;
- The possible future special distributions forgone in each category of policy have been imported from the fund-level model into the policy-level model under the two bases used by the policyholder advocate (Aviva new business assumptions and policyholder advocate new business assumptions);
- The possible future special distributions forgone in each category have been used to calculate the approximate benefits forgone by each policy; and
- The PIP allocation methodology proposed by Aviva, including the minimum PIP amount, has been applied to the adjusted PIP liabilities of each policy to estimate the PIP allocation of each policy.

In addition, it should be noted that high-level adjustments can be made to the fund-level model to reflect, for instance, changes in the value of the inherited estate resulting from actual investment returns. No such adjustments can be made, however, to the policy-level data to reflect changes in individual PIP Liabilities of policies as a result of investment returns after 21 November 2006. The policy-level model therefore represents a "snapshot" of the position at November 2006 that cannot be updated in the light of subsequent experience without a further data extract by Aviva.

The value of the inherited estates has fallen since the end of 2007 due to negative returns on the equity and property components of the funds' asset portfolios. The value of PIP liabilities in the policy-level model has not been updated to reflect their probable corresponding fall in value. In principle, however, that does not affect the validity of analysis using the two models. The reason is that adjustments can be made to the fund-level model, so that the value of potential special distributions forgone by eligible policyholders can be calculated at a range of dates, including the end of 2007, at the end of 2008 and at the assumed effective date of the reattribution, 1 October 2009.

Outputs

LECG has used the policy-level data model to assess the following aspects of the reattribution:

- The position of non-electing policyholders under a reattribution (set out in appendix 44: Position of non-electing policyholders); and
- The comparison of potential individual special distributions forgone with the individual PIP allocation amount offered by Aviva (set out in appendix 45: Formulation of guidance to policyholders)

In these analyses, LECG has compared the calculated potential special distributions forgone by each individual policy in the policy-level data to its PIP allocation. For modelling purposes, policyholders with policies whose PIP allocation is greater than or equal to their benefits forgone are assumed to elect for Aviva`s proposals. Potential non-electors are those policyholders with policies whose benefits forgone exceed their PIP allocation