MARKET-CONSISTENT VALUATIONS OF LIFE INSURANCE BUSINESS: THE U.K. EXPERIENCE

A report for the Society of Actuaries

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EXECUTIVE SUMMARY

Introduction

U.K. life insurers writing participating business have, since the end of 2004, been required by their regulator, the Financial Services Authority (FSA), to value their assets and liabilities on a market-consistent basis. This was intended to provide a more relevant and reliable basis for measuring and regulating the solvency of life insurers than the traditional approach using a net premium valuation.

The purpose of this paper is to:

- Explain the new valuation approach based on market-consistent values, and its rationale;
- Set out the issues faced by life insurers in implementing the new regime; and
- Explain how insurers addressed these issues—in particular, the importance of the modelling techniques they used—and how insurers' practices varied.

Implementing the new regime was a major challenge but has had positive achievements. It has been particularly useful in highlighting the importance of the guarantees and options of insurers. However, we find that the value placed on guarantees and options depends partly, but significantly, on what economic model the insurer has used. We

suggest further research to understand why models that look to provide market-consistent values do, in practice, provide markedly different values.

The new rules: which products do they apply to?

The new rules apply to major life insurers writing participating business. Participating policies, written by both stock and mutual insurers, have traditionally been an important part of the U.K. market, and are essentially a form of savings contract, with some life insurance cover, together with guarantees, options and ”smoothing.” The guaranteed payout increases over time as annual bonuses (dividends in U.S. terminology) are declared and added to the policy. The assets backing policies are usually a mixture of bonds, equities, property and cash. A policyholder’s premiums accumulate over the course of the policy, with the investment return earned; when we make a deduction for claims, expenses, tax and profits transferred to shareholders, the outcome of this calculation is the “asset share,” i.e., the share of the insurer’s assets that can be attributed to the policy.

At maturity, the policyholder typically receives a payment about equal to the asset share, but it may differ; for example:

- The guaranteed benefit must be paid if it exceeds the asset share;
- Some policies contain options (particularly important are guaranteed annuity options): when exercised, they can add to the liabilities of insurers;

- While the asset share changes daily as asset values vary, insurers aim to provide policyholders with a more stable payout using "smoothing" and therefore change bonus rates only infrequently (say twice a year): this may mean payouts are either above or below asset shares.

The traditional valuation of liabilities used a net premium valuation, with the benefits valued excluding any future bonuses (at least explicitly). This was not "realistic" and lacked transparency. When the FSA took over responsibility for insurance regulation in the United Kingdom in 2001, it wished to understand the solvency of life insurers on a more realistic basis, and it set about designing a new regulatory regime to achieve this.

A new approach: "market-consistent" valuations

FSA decided that the "realistic" valuations should use market-consistent values of assets and liabilities. In other words, insurers should value their assets and liabilities in the same way that the market uses to price other financial instruments. This could have been called fair value; however, given that the meaning of fair value was being debated in the discussions on insurance accounting, it was a term best avoided.

For assets, market consistency is typically market value, since most assets of life insurers are traded. Traditionally, the United Kingdom has largely used assets at market value already, but insurers now had to include (the market value of) assets that were previously inadmissible.

The valuation of liabilities was more problematic. At maturity, the insurer expects to pay the asset share to the policyholder, so the asset share as accrued to the balance sheet date, with the assets at market value, is an appropriate market-consistent starting point. However, the insurer has to account for the additional amounts payable from guarantees, options and smoothing. Can this be assessed on a market-consistent basis?

The approach to valuing guarantees was to regard participating policies as comprising the asset share and a put option, i.e., an option to sell the accumulated assets for the guaranteed amount, which option would be exercised if the asset share was lower than the guarantee. So, can we look up the prices of put options and then place a value on the guarantees? Unfortunately, no, because put options in the market do not extend as far as the 35 years or more that life policies last, and because it may not be easy to find put options on all the assets that make up the asset share, in particular property.

Therefore, insurers typically use an economic scenario generator (ESG), being a stochastic model that projects scenarios of future interest rates, shares and other asset prices, which is calibrated to the prices of put options as quoted on the market at the balance sheet date, and then used to work out the prices of other put options on a basis that is intended to be market-consistent.

The ESG will be run to produce some thousands of scenarios, but it is too complex to run it in conjunction with all individual policy data, so a model of the insurer's business is

used. The outcome enables the insurer to assess the probability of the guarantee exceeding the asset share and hence the value of the extra payments it expects to make. The model can also be used to place a value on the options under policies, and on payments being above or below asset share as a result of smoothing.

The FSA rules also refer to "management actions," such as an insurer changing its investment strategy to reduce the likelihood that the guaranteed benefit exceeds the asset share. If the valuation is to realistically represent the future, the model needs to incorporate "management actions." However, this is complex to model, and FSA allows firms discretion regarding whether or not they incorporate the effect of management actions.

Issues in implementing the new requirements

The new rules were implemented at 31 December 2004, following a hectic three-year period for the regulator, the life insurance industry and the actuarial profession. Insurers faced several issues in implementing the rules. We focus here on how they valued their liabilities, which is where the main challenges have been.

The main issues were as follows, and we then set out how firms have addressed these; we give particular emphasis to where insurers have adopted different approaches:

- How do insurers use an economic scenario generator model?
- How do insurers build a model of their business?

- Do insurers incorporate the effect of management actions?
- How many projections do insurers make?
- Do insurers have controls to ensure the results are accurate?

The research is based on the valuations carried out by the 37 insurers reporting on the new regime at the end of 2005.

How do insurers use an economic scenario generator model?

Sixteen of the 37 insurers used a model provided by Barrie Hibbert (BH); nine used The Smith Model (TSM); and the remainder used either an internal model or a model from another provider. ESG providers allow insurers to vary the approach and/or assumptions in their models, to some extent.

Insurers can use risk-free rates and asset volatilities, deduced from market prices, to help calibrate the model they are using. However, we can see that there are differences between firms in their modelling, because each insurer has to report what its model produces for specimen put option prices. If an insurer reports a relatively high put option price, this implies it would put a relatively high figure on its liability for guarantees. The large differences throw doubt on whether the models, as operated, are really market-consistent. We have data for five-, 15-, 20-, 25- and 35-year options, on risk-free bonds, corporate bonds, equities and property (and some combinations of these), at, in and out of the money. We find:

- There are significant differences between insurers in the put option prices they are using: e.g., if we look at 15-year at-the-money put option prices on equities, one firm (the highest) has a price that is 72 percent more than the lowest;
- There is a greater variability for long-dated than short-dated put options (the highest is 83 percent greater than the lowest for a 35-year put option on equities);
- Out-of-the-money put options have greater variation in prices between insurers, compared with at-the-money and in-the-money put options;
- The variation in prices of put options on risk-free bonds is especially high, as one group of three insurers' modelling produces put option prices for 15-year at-the-money put options that are 65 percent higher than the next highest price;
- Put option prices on property have relatively low variability, which reflects insurers making similar assumptions about property price volatility (property options are not, in practice, available).

We also find significant differences between firms using different models. In many cases, firms using the BH model had the highest put option prices, then insurers using TSM, with those using the "other" models having the lowest. For 15-year at-the-money put options on equities, insurers using the BH model had a put option price 8 percent higher than the average; insurers using TSM 4 percent lower than average; "others" being 10 percent less than average. There is also significant variability among insurers using the same model (this tends to be greater for insurers using the BH model than TSM: e.g., for 15-year at-the-money put options on equities, the coefficient of variation of insurers using the BH model was 8.2 percent, while it was 3.1 percent for those using TSM).

The option prices used by financially weak life insurers were often lower than those used by stronger firms. However, these differences are generally not statistically significant: the main driver for differences is the model (and the assumptions in the model) that the firm is using.

How do insurers build a model of their business?

Insurers have to develop a model of the business so that running the projections is feasible. Between 2004 and 2005 they increased the number of "model points" they used: the average "compression factor" increased from 1.95 percent to 3.21 percent (i.e., the number of model points was 3.21 percent of the individual policies).

It is important to choose model points that accurately represent the business, especially as regards to whether guarantees are in-the-money or not, and some insurers reported checks they carried out to confirm this.

Do insurers incorporate the effect of management actions?

Some insurers built management actions into their models, others did not. This introduces an unfortunate inconsistency when comparing insurers' financial strength.

The author's view is that it is a priority to incorporate management actions; and that, in the meantime, insurers should disclose any actions they have not modelled.

How many projections do insurers make?

Life insurers run projections of their stochastic model, the number varying from 500–10,000. Larger insurers tend to use more projections, but not proportionately more. Some insurers reported how the results converged when using a larger number of simulations.

Do insurers have controls to ensure the results are accurate?

One concern is that, when the new rules were introduced, insurers' systems may not have been robust. Insurers did build in a number of checks on their models. However, several made adjustments to their 2005 valuations, suggesting that the initial results at 2004 were not correct. One insurer that had £1805m capital in 2004 gained £214m in 2005 as a result of a model change and a further £35m from changing the grouping of policies into model points. "Improvements to the stochastic model code" in another firm led to a £156m reduction in its £697m capital. Clearly, it is to be hoped that regime settles down and there are fewer such changes in the future.

Conclusions

The U.K. participating life insurance sector has experienced a radical change in its financial reporting. It has taken a tremendous effort by the regulator, the industry and the actuarial profession to achieve this.

The realism of the methodology is regarded as very helpful: in the past, the assets and liabilities were intended to be on a prudent basis, but no one knew how prudent they were, if there wasn't a realistic benchmark. The market-consistent approach is now put forward as a realistic approach. Its transparency has led to a better understanding of life insurers' finances, especially regarding guarantees and options.

The modelling that life insurers are now doing involves:

- Using stochastic models to generate economic scenarios; calibrated to the market prices of options where possible, and then used to estimate a market-consistent value of the guarantees and options that they have granted;
- Applying this to a model of the business based on model points, which have to be chosen to represent the business appropriately; and
- Where possible, including management actions in the modelling.

However, there are further challenges ahead:

- What economic scenario generator an insurer uses can make a big difference to the reported value of its guarantees and options: more work is needed to understand (and, perhaps, reduce) these differences;
- Incorporating “management actions” more fully is important; and
- Further controls are needed so that we do not see a continuation of the errors that arose when the new regime was introduced.

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1. INTRODUCTION

There is no uniform method for insurers to prepare their accounts, and the variety of practices worldwide means that it can be difficult to compare the performance of different firms. The International Accounting Standards Board (2007) has a project to design a new standard for insurance contracts but many issues remain to be agreed.

These issues are of interest to insurance regulators, who also require insurers to value their assets and liabilities, so that they can examine insurers' solvency from the perspective of policyholder protection. However, it is difficult to protect policyholders when there is uncertainty as to how to value an insurer's assets and liabilities.

This paper examines developments in the United Kingdom, where the regulator, the Financial Services Authority, has required, from 2004, insurers writing participating life business to value their assets and liabilities on a market-consistent basis. Insurers had to adopt new actuarial methods and models to do this.

The purpose of this paper is to:

- Explain the new approach based on market-consistent values, and its rationale;
- Set out the issues faced by life insurers in implementing the new regime; and
- Explain how insurers addressed these issues—in particular, the importance of the modelling techniques they used—and how insurers' practices varied.

2. PARTICIPATING BUSINESS IN THE UNITED KINGDOM

Participating policies, written by both stock and mutual insurers, have traditionally been an important part of the U.K. market, and are essentially a form of savings contract, together with guarantees, options and ”smoothing.” The guaranteed payout increases over time as annual bonuses (dividends in U.S. terminology) are declared and added to the policy. The assets backing policies are usually a mixture of bonds, equities, property and cash. A policyholder’s premiums accumulate over the course of the policy, with the investment return that has been earned; when we deduct claims, expenses, tax and profits transferred to shareholders, the outcome is the “asset share,” i.e., the share of the assets of the insurer that can be attributed to the policy. Further details on the operation of participating policies are given in Appendix 1.

At maturity, the policyholder’s payout is typically about equal to the asset share, but it may differ. For example:

- The guaranteed benefit must be paid if it exceeds the asset share;
- Some policies contain options: particularly important are guaranteed annuity options, where the policyholder can choose to use the maturity value to buy an annuity at a rate specified when the policy began; these have become more valuable in recent years and can, when exercised, add to the liabilities of insurers;
- While the asset share changes daily as asset values vary, insurers aim to provide policyholders with a more stable payout using “smoothing” and therefore change

bonus rates only infrequently (say twice a year): this may mean payouts are either above or below asset shares.

3. REGULATORY BACKGROUND

Prior to 2004 the solvency regime for participating life insurers used a net premium valuation, to be carried out with assumptions on a prudent basis. However, the valuation excluded any future bonuses. Insurers did use a low rate of interest in the valuation as implicit allowance for future bonuses: however, the outcome was not transparent. Indeed, given that the business was operated with payouts based on asset shares, the valuation did not reflect what the liabilities were in practice. Neither did the net premium method cope adequately with guaranteed annuity options, traditional actuarial techniques not being designed to recognise the time value of options.

So, was the traditional valuation actually prudent if there was no realistic benchmark to compare it with?

Developing a new regulatory regime

The FSA became responsible for insurance regulation in 2001, and decided it made more sense to have a realistic valuation, including, in particular, future bonuses in the liabilities. A realistic regime would also value guarantees and options in the same way capital markets would value them: a market-consistent basis

The new approach was developed between the FSA, the actuarial profession and the industry over 2002–04: a short timescale for such a major development. The contribution of the actuarial profession was to develop rapidly the capability to perform complex financial projections on a market-consistent basis, taking into account advances in modelling that had been taking place in recent years.

The changes were introduced in conjunction with new "stress tests" that led to a new minimum capital requirement known as the "risk capital margin,'" which is considered in more detail in Appendix 3.

The FSA has also made several changes to the way it regulates the conduct of insurance business, including a new principle: "Treating customers fairly." It now requires participating life insurers to be more specific about how they run their funds, and they have to issue a "Principles and Practices of Financial Management" (PPFM) document, which sets out how they run the business (FSA, 2005).

4. THE NEW REALISTIC REPORTING RULES

The rules require participating life insurers, having participating liabilities exceeding £500m, to prepare and publish a "realistic balance sheet," the intention being that this is a market-consistent valuation of assets and liabilities. This section mentions the main points in the rules, with further detail in Appendix 2.

Realistic value of assets

The United Kingdom has traditionally largely used assets at market value, but not wholly, so some adjustments are needed, which are listed in Appendix 2.

The major actuarial issue is to include the value of future profits on non-participating policies, which are essentially an asset available to the participating business. Insurers must use a methodology and assumptions which involve reasonable (but not excessively prudent) adjustments to reflect risk and uncertainty; allow for a market-consistent valuation of any guarantees or options and have regard to generally accepted actuarial practice and generally accepted industry standards appropriate for long-term insurers.

Realistic value of liabilities

Valuing the liabilities is more complex. The regulator adopted the principle of market consistency so that, in principle, liabilities are on a comparable basis to assets. Appendix 2 summarises the relevant rules; here, we focus here on the two main actuarial issues: the use of asset shares, and the valuation of guarantees and options.

To calculate asset shares, the insurer needs data on investment returns, expenses, tax, etc., for many years in the past, but accurate information may not be available and approximations are needed (Hare et al., 2005). Shelley et al. (2002) described the asset

share systems of some insurers as “rudimentary,” implying that some had much work to do before the new regime was introduced at the end of 2004.

FSA recognises that, in some cases (e.g., paid-up policies), asset shares may not be calculated, so the rules do not insist on asset shares being used, and refer to a more general term, “with-profits benefits reserve” (WPBR). Insurers can calculate this by a prospective method as the excess of the present value of benefits and expenses over the value of future premiums, as an alternative to calculating the asset share.

Firms are required to calculate the costs of guarantees, options and smoothing on a market-consistent basis using one or more of the following three methods:

- a stochastic approach using a market-consistent asset model;
- using the market costs of hedging the guarantee or options;
- a series of deterministic projections with attributed probabilities.

The stochastic approach is most commonly used. The starting point is an economic scenario generator (ESG), being a market-consistent asset model, which produces a large number of alternative scenarios, each consisting of financial conditions in the future, over a period that is long enough to cover the liabilities. The insurer also needs to assess, on each such scenario, the value of the firm’s liabilities. The cost of the guarantees and options equals the average of such costs on each of the scenarios. Insurers have to document their asset model and the assumptions they have used.

Insurers have to reflect policyholder actions, e.g., surrenders or exercising options for guaranteed annuities. They are allowed to reflect the management actions that they plan to take (e.g., changing assets if solvency worsens), but this is not compulsory.

While the thrust of the rules is that the valuation of liabilities must be realistic rather than prudent, there are some minor areas where prudence may appear to be included. The author suggests this is unsatisfactory and considers it further in Appendix 2.

5. THE NEW REGIME: PRINCIPLES

The relevance of market consistency

The regulators have set market consistency as a principle, and this can have considerable merit, although it does raise some issues (see Sheldon & Smith, 2004). There is the apparent advantage of objectivity compared to discretionary assumptions that insurers may make in a valuation, where we know from research on non-life business that insurers' financial position may influence the liabilities they determine (see, e.g., Petroni, 1992 and Diacon et al., 2003). In addition, market consistency means that an insurer can, at the point of measurement, transfer its obligations to a third party, hence providing security for policyholders. This is not watertight, however. If, in practice, the risks are not hedged, there is the risk that markets change, and that the assets turn out to be insufficient to secure the buy-out.

Market consistency may imply allowing for credit risk in valuing the liabilities. However, for a solvency valuation, we want to know if the insurer has enough assets to meet the liabilities in its insurance contacts, so it is right to use a risk-free rate.

Modelling the cost of options and guarantees using option prices

A difficult issue is how to value guarantees and options. We can regard a participating policy as paying the greater of the asset share and the guaranteed amount. Therefore, the policy benefit is the asset share plus a put option, i.e., the option to sell the assets for the guaranteed amount, which would be exercised if the asset share was lower.

Insurers can then use the prices of put options to value their guarantees. However, in practice, relevant data on put option prices is hard to collect (Sheldon & Smith, 2004). Traded option prices are typically of short duration (up to 2 years) and therefore of limited use for most life insurance valuations. Longer-dated option prices, out to say 5 years, may be available as over-the-counter quotes from banks, although such options are only traded infrequently, and the results may not be reliable. Data is also available from commercial data providers, but this depends on the extrapolations they use in their models from shorter-term data. Sheldon and Smith point out a further difficulty: option prices are quoted with reference to indices that do not correspond exactly to the assets that insurers actually hold.

Since insurers cannot work from published option prices, they need to construct models that give put option prices they can use. An "economic scenario generator" (ESG) will produce scenarios from which the price of relevant options can be deduced. Two approaches are used by insurers. First is the risk neutral approach, where the expected returns for each asset class are adjusted to be the risk-free rate of return (which is then used as the discount rate). The alternative is the deflator approach: any stochastic model can be used, although usually a real world model, and a set of discount factors, the deflators, is produced to calibrate the model to produce prices consistent with the market (Jarvis et al., 2001).

Closed form approaches are an alternative, which Sheldon & Smith (2004) suggest may be under-used. They can have a number of advantages, including fast computation, avoiding the need for simulations and the sampling error inherent in simulation models. However, such solutions are not always available—for example, where the investment mix depends on the solvency of the fund.

Constructing a suitable model is complex. For example, we know that implied equity market volatility varies by term into the future and by moneyness of the options, but some models have only a constant level of volatility (Eastwood, 2005). Sheldon & Smith (2004) also discuss the problems in modelling interest rate volatility.

Discount rate

Where the insurer discounts using a risk-free rate, it needs its model to determine such a rate or, more strictly, a set of risk-free rates according to term. It is common practice in the capital markets to use a risk-free rate derived from swap rates. Dullaway & Needleman (2004) say, "Swap rates can be thought of as representing the (essentially risk free) rate at which high credit quality institutions can borrow or lend, providing they maintain their credit quality." Using swap rates would give a risk-free rate around 20-30 basis points above gilts.

The Board of Actuarial Standards (2006) indicates that credit can be taken for that part of the excess yield on swaps over gilts, which cannot be accounted for by credit risk. Several insurers have interpreted this as meaning they can use a rate 10 basis points above gilt yields. However, Sheldon & Smith (2004) ask, "If the swaps are truly risk free, then why would an office knowingly accept lower than a risk free return on its gilt portfolio?"

Non-market risks

Insurers need to allow for non-market risks: in particular, mortality. However, a market for mortality risks is only at a very early stage (Blake et al., 2006), and while reinsurers' prices may be used, they may reflect more favourable tax and solvency regimes than

direct insurers. Hare et al. (2004) concluded that a market-consistent valuation basis for mortality was not feasible at present, and that a prudent deterministic approach should suffice. FSA rules refer to best estimates of mortality being used: indeed, if the risks are non-systematic, then, arguably, market-consistent values can be produced by using best estimate assumptions.

It is important to understand the mortality assumptions that an insurer has made (especially for guaranteed annuity options). In their report on the traditional valuation, insurers disclose not only the annuitant mortality table they are using but also the expectation of life at age 65 and 75: this simplifies comparisons between firms. The author believes it would be helpful if this was also disclosed for the realistic valuation.

Management actions

Firms have discretion on whether to include management actions in their model, and some may decide not to do so because "trying to reflect the complex interactions between the financial condition of the company, bonus policy and investment policy, in a wide range of future economic and operational scenarios, over a period of forty years or more, is, in fact, extremely difficult in practice" (Dullaway & Needleman, 2004). Where future management actions depend upon the then current solvency position, modelling future solvency in each possible scenario requires a vast increase in the number of simulations required (Dullaway & Needleman, 2004).

However, a realistic balance sheet requires realism in management actions (Tuley, 2005). Hibbert & Turnbull (2003) show that, for a specimen policy, the realistic value of the guarantees is halved when the firm moves from assuming a static investment policy and bonus policy to a policy where, in the event of worsening solvency, the investments are switched towards bonds, and bonus rates are reduced. However, insurers now have lower annual bonus rates than previously, and the equity content of funds is generally lower, so that the impact of management actions on the value of liabilities is likely to be less (Sheldon & Smith, 2004).

6. THE NEW REGIME: PRACTICE

Methodology

We are able to analyse the results for all 37 insurers publishing a realistic valuation at the end of 2005, using their balance sheets (with data from the SynThesys life database of Standard & Poor's) and valuation reports. The realistic assets averaged 102 percent of the assets in the traditional valuation, although the figure was 114 percent for one firm (see Appendix 4). Some insurers had substantial liabilities for guarantees and options, now calculated on a "realistic" basis.

We now turn to the main issues faced by insurers.

How do insurers calculate the value of non-participating business?

The present value of future profits on non-participating business amounted to nearly £10bn in 2005. However, there were important differences between insurers in the assumptions they used. Future investment returns varied from 3.50 percent to 4.50 percent p.a., while discount rates varied from 4.04 percent to 8.00 percent (see Table 3). Some firms used a future investment return equal to the risk-free rate, and discounted future cash flows at either this rate or a higher rate (which may be a way of allowing for non-market risks). The risk-free rate may be a fixed rate or may vary by term: the latter approach was used by nine firms out of 25 in 2005 (seven out of 25 in 2004).

One query is why the average expense inflation assumption is as high as the mean of 3.75 percent in 2005. This is significantly higher than average inflation measured by the GDP deflator in 2000-05 (2.6 percent p.a.) and the U.K. government's inflation target of 2 percent p.a. It may be thought that expenses would increase in a similar proportion to earnings (as was assumed in the U.K. trade body's inter-office expense investigation: see Luffrum et al., 1986): this will produce a higher figure. However, although most of an insurer's expenses may be earnings of staff, we would expect productivity increases so that unit costs increase in the same proportion as prices, i.e., lower than the rate of earnings inflation. The expense inflation assumptions do look high and should be questioned by the regulator.

How do insurers calculate the with-profits benefits reserve prospectively?

Where the WPBR is calculated on a prospective basis, insurers set out the assumptions they have used (summarised in Table 4). In principle, the valuation of liabilities should be unaffected by choice of future investment return, but insurers' choices covers a wide range, from under 4 percent to over 7 percent. This appears unsatisfactory although, in practice, there is an offset as investment returns are closely correlated with discount rates (which varied from 3.70 percent to 7.00). Perhaps a commonly accepted approach will emerge over time. We also note that the average expense inflation assumption, at 3.97 percent, appears high.

Insurers also set out the per policy expense assumptions they have used. It is puzzling to see a number of firms where the assumptions changed markedly between 2004 and 2005. Looking at life policies, there were three firms (out of 14) where the expense assumption changed by more than 25 percent, with one increasing by 52 percent from £37.19 to £56.52. For pension policies, there were three (out of eight) insurers with changes of more than 25 percent. This suggests that some firms are making significant changes in the way they analyse expenses, an area the regulator may wish to query.

Do insurers use stochastic modelling to value guarantees and options?

All firms use a stochastic approach with a market-consistent asset model, with the exception of one firm, which has a close matching investment philosophy to such an extent that it regards the fixed interest portfolio as effectively a replicating portfolio for the guarantees and options within the participating fund.

Three insurers also used the market cost of hedging for some of their liabilities; and five used deterministic projections for part of their business.

How do insurers use an economic scenario generator model?

A number of firms (including some consulting actuaries) make economic scenario generator models available to insurers for use in realistic valuations. We can ascertain, from information on the BH Web site, that 16 life insurers used the Barrie Hibbert (BH) model in 2005. We also find that there are nine firms using The Smith Model (TSM), this being referred to by insurers in their realistic valuation reports. Model providers do have alternative versions of their model, and insurers can calibrate a model in different ways. Davidson (2005) refers to insurers wanting to have control over the assumptions in the model they are using, together with a comment that "the authorities are trying to wean life companies off using consultant-generated scenarios and encouraging them to do their own calibration."

We show examples of insurers' descriptions of their ESG models:

- "We used a stochastic model for options and guarantees, with the asset returns generated by a proprietary model, with the calculations carried out using a risk-neutral approach."
- "The method used is a Monte Carlo projection of the with-profits benefits reserve and the guaranteed amounts allowing for investment returns and bonuses. The investment returns and bonuses used depend on the underlying investment conditions in each scenario and on the asset mix backing each class of business. The values of guarantees, options and smoothing are obtained by averaging the relevant discounted amounts."

The key components from a model are the risk-free rate, volatilities of asset classes, and correlations of returns, since these determine the put option prices that are generated. Some examples of insurers' descriptions of how their model operates are:

- "Risk-free rates were taken as the gilt rates prevailing at the valuation date plus 10 basis points. A LIBOR market model calibrated to gilts plus 10 basis points is used. The volatility within the model is calibrated to market-implied volatilities for 20 year at-the-money swaptions."
- "Nominal short-term interest rates are assumed to follow a two-factor version of the Black-Karasinski model. Volatility of interest rates has been calibrated to the implied volatility of swaption prices."
- "The asset model used to project future investment returns is "The Smith Model" (TSMplus) which is proprietary software owned by Deloitte. This is a deflator

model. The model of the with-profits business uses the output from the asset model to project investment returns on equities, government bonds and cash. The asset model produces investment returns for the three markets that are modelled: U.K., U.S. and Euro-based markets. Each set of returns was calibrated to reproduce certain swaption and equity prices as at 31 December 2005."

- "Corporate bond returns are modelled as a gilt return plus additional volatility. This is an approximation to the Merton model which suggests that the return on a corporate bond can be decomposed into the return on a risk-free bond and the return on a put option on the value of a firm. The additional volatility for corporate bonds over gilts was determined from a historical index of corporate bond returns."
- "Corporate bond holdings are modelled as though they were government bonds."
- "For U.K. equities, market implied volatility has been derived from various investment banks and other sources. The model used can only utilise a level volatility across all terms. The assumption used of 20 percent is consistent with the output for a term of about 10 years, which is consistent with the term of the majority of the guarantees, and gives a margin for prudence for short-term guarantees."
- "The equity model uses a local volatility surface calibrated to market implied volatilities for a range of strikes and maturities. Volatilities are assumed to be constant beyond quoted strikes and maturities."
- "Property holdings are modelled as a mix of equity and gilt assets, calibrated to derive a level of running yield and volatility as observed in historical data."

- "Correlations between interest and equity returns are estimated using 10 years of historical weekly data. Ten years of monthly data is used to estimate correlations with the retail prices index."

Evidence from put option prices

Insurers report the value that their ESG model produces for specified put options. These are put options on a portfolio worth £1,000,000 on the valuation date exercisable n years later, with strike price of K * £1,000,000 * $(1 + r)^n$. n is the duration (5, 15, 25 and 35 years); r is the risk-free rate used by the insurer; K = 0.75, 1.00 and 1.50 (so K = 0.75 is an out-of-the-money option, K = 1.00 is at-the-money and K = 1.50 is in-the-money). The options are to be valued with reinvestment of any dividend income into the FTSE All Share Index, and reinvestment of any rental or other property income into U.K. property. The property options should relate to a well diversified portfolio of U.K. commercial property. References to 15-year bonds mean rolling bonds traded to maintain the 15-year redemption date in the future. The corporate bonds should be assumed to be rolling AA rated zero coupon bonds. A relatively high value for the option means that the firm would assess its liabilities for guarantees and options at a relatively high level. Firms do not have to supply figures if that option is insignificant to the firm's valuation (e.g., if it does not have property in its portfolio).

We summarise the results in Appendix 6. Tables 5 and 6 refer to risk-free rates, later tables to option prices. We show mean option prices for the four categories of assets

(shares, property, risk-free bonds and corporate bonds) and for three portfolios of combinations of assets. We show the mean separately for firms using the BH, TSM and other models. We also show the coefficient of variation, both overall, and for firms using the BH, TSM and other models. We show the minimum and maximum option price reported. The tables go on to show the mean option price separately for firms with relatively high and low financial strength, depending on whether the firm's financial strength is more or less than the (weighted) average for the 37 firms.

The tables initially consider options that are at the money, i.e., K=1.00. We then present a summary of the results for out-of-the-money options (K=0.75) and in-the-money options (K=1.50).

We summarise the main findings as follows:

- Insurers use different rates as the risk-free rate (some use gilt yields; others take credit for some of the higher yield that can be obtained from swaps);
- There are significant differences between insurers in the put option prices they are using: e.g., if we look at 15-year at-the-money put option prices on equities, one firm (the highest) has a price that is 72 percent more than the lowest;
- There is a greater variability for long-dated compared to short-dated put options (the highest is 83 percent greater than the lowest for a 35-year put option on equities);
- Out-of-the-money put options have greater variation in prices between insurers, compared with at-the-money and in-the-money put options;

- The variation in prices of put options on risk-free bonds is especially high, reflecting one group of three insurers whose modelling produces markedly higher put option prices than other firms (65 percent higher than the next highest price for 15-year at-the-money put options);
- Put option prices on property have relatively low variability, which reflects insurers making similar assumptions that property price volatility is about 15 percent (property options are not, in practice, available); and
- Put option prices with differing moneyness (K = 0.75, 1.00, 1.50) are closely correlated (see Table 18).

We also find that there are significant differences between firms using different models. In many cases, firms using the BH model had the highest option prices, and insurers using TSM often had higher prices than those using the "other" models. In the case of 15-year at-the-money put options on equities, insurers using the BH model had a put option price 8 percent higher than the average, insurers using TSM 4 percent lower than average, "others" being 10 percent less than average. Nevertheless, there is still significant variation among insurers using the same model. The variability tends to be greater for insurers using the BH model compared to those using the TSM: for example, considering 15-year at-the-money put options on equities, the coefficient of variation of insurers using the BH model was 8.2 percent, while it was 3.1 percent for those using TSM.

The option prices used by financially weak life insurers were often lower than those used by stronger firms. However, these differences are generally not statistically significant. Regression analysis demonstrates that the driver for differences in put option prices between firms is the model (and the assumptions in the model) that the firm is using.

The variation in option prices between insurers raises some concerns, and the author suggests FSA review why there are such large differences; further research is needed. An insurer that adopts assumptions that give an option price (e.g.) 20 percent more than another would be expected to have a 20 percent higher liability for its guarantees. In practice, of course, an insurer's valuation of its guarantees will depend not on one option price, but will take into account the range of guarantees it has, with different terms and moneyness and related to a variety of asset classes.

Correlations

One reason for differences in put option prices is that insurers use different assumptions about how the returns on asset classes are correlated (high assumed correlation leads to high option prices).

Correlation assumptions are disclosed in insurers' valuation reports, and these illustrate some large differences: see Table 20. In particular, some assume a positive and others a negative correlation between returns on equities and bonds.

Some differences may have arisen because FSA has not been precise in defining what correlations should be disclosed (an area the author suggests FSA address). Correlations depend on the time horizon, can change over time and under market conditions. Tail correlations are also important, given that major market changes can upset the traditional pattern of market movements, although including this effect in models can be difficult (Davidson, 2005).

How do insurers build a model of their business?

It is impracticable to project cashflows forward on some hundreds or thousands of scenarios for each policy that an insurer has on its books. They therefore use "model points" to represent the business as a whole, and have to state how they have chosen to group policies into representative model points. A sample of answers is:

- "Contracts are grouped according to their major product features, term gone and term to go, policyholder age and the extent to which guarantees are in or out of the money."
- "Contracts were grouped such that the grouping had sufficient granularity to ensure that the underlying policy features were not materially lost. In particular, due regard was taken of key features such as premium frequency, policyholder age and sex as well as the timing and moneyness of guarantees."

Firms explain how they check that their grouping does not introduce inaccuracies. For example:

- "The impact of grouping was tested by comparing the results obtained from running 100 of the scenarios through the stochastic model on both grouped and "ungrouped" data. The 100 scenarios were chosen so that the cost of guarantees from the stochastic simulations was comparable with the value obtained by running all 2,000 simulations. The "ungrouped" data was based on 92,826 model points that have been demonstrated to be representative of the whole portfolio by reproduction of statutory reserves calculated on an individual policy basis. The results of the test were that the future costs of guarantees, financial options and smoothing in respect of the "ungrouped" data differed by less than 0.5 percent."
- "For each product line, the effect of any grouping was tested by comparing the statutory reserves calculated for the (grouped) liabilities with the actual statutory reserves. The number of contracts, total office premiums and total guaranteed benefits were also compared at product line level."

We can calculate, for each insurer, the "compression factor," i.e., the number of model points divided by the number of individual contracts. In 2005 this varied from 0.01 percent to 25.10 percent, averaging 3.21 percent. The factor in 2005 was, for every insurer, higher than in 2004, when it averaged 1.95 percent. Large firms tend to have a lower compression factor than small firms.

Life insurers have to incorporate the effect of policyholder actions; in particular, the proportion of policyholders who exercise guaranteed annuity options. Some insurers assume that proportion to be constant. We may expect greater sophistication in future, as evidence develops of how the take-up of options varies (e.g., it may be higher when interest rates are low, as the option is then more valuable) and as modelling capabilities develop, and some insurers have already made progress in this direction.

Do insurers incorporate the effect of management actions?

Insurers are allowed to take account of management actions. For example, some assume that the annual bonus rate they declare depends upon the firm's solvency; or that they adopt a dynamic investment strategy, e.g. changing their asset mix away from equities and towards bonds if their solvency declines. The analysis of a sample of 16 funds by Turnbull (2006) suggests that some firms are using management action assumptions to significantly reduce liabilities. Assuming the actions are consistent with management strategy for running the fund, that is right and proper.

Where management actions are taken into account, it is complex to model, and some firms make approximations. One indicates: "The stochastic model cannot reflect all possible actions and so it includes assumptions to broadly reflect the likely decisions."

Some insurers do not incorporate management actions or do not do so fully, so that their financial strength is understated. This also has consequences for the management of the

business. FSA rules require participating insurers to review annually whether they have excess capital and, if they have, to consider distributing the excess. However, if the capital is not calculated on a fully realistic basis, it is difficult to see how that review can be carried out in the way it ought to be. The future challenges for actuaries will certainly include extending models so as to be able to include management actions more effectively. In the meantime, the author suggests insurers disclose planned actions that have not been included in their calculations.

How many projections do insurers make?

The number of simulations used by insurers varied from 500 to 10,000 (average: 3,343). These figures for 2005 were the same as in 2004. The number of simulations is positively related to the size of firms, although very large firms do not run a proportionately larger number of simulations. Firms using the BH model or TSM tend to use more simulations, independent of size, than firms using other models.

Insurers' comments on their choice of number of simulations included:

- "The valuation has been based on 5,000 stochastic simulations. Tests showed that little additional accuracy would be achieved by running more than 5,000 simulations. In particular, the results produced using 1,000 simulations were very similar to those produced using 5,000."
- "Assets and liabilities were projected on 3,000 scenarios. At 1,000 scenarios, the result converges to a plus or minus £11 million movement using a 95 percent

confidence interval. With 3,000 scenarios, the result converges to plus or minus £10 million. At 11,000 scenarios it is estimated to be plus or minus £3 million. It is believed that a result with 3,000 scenarios is reasonable, providing an acceptable level of accuracy without a disproportionate increase in run time."

Do insurers have controls to ensure the results are accurate?

Insurers report on the checks they have carried out. In particular, they can check that the average discounted value of £1 invested in an asset equals £1, for all asset classes, which is as it should be for a market-consistent model, to satisfy the no-arbitrage rule.

The valuations are subject to audit, and auditors have been heavily involved as the new regime was implemented. However, the new rules have presented challenges to auditors as well as insurers, and we expect that there will be a tightening of controls in what is a complex process.

The outcome as regards accuracy raises some discomfort. One concern is that insurers' systems may not have been robust enough to cope with a radically different regime that was introduced quickly. We gain some insights into the problems as some insurers' analysis of the change in valuation result over 2005 indicates correction of errors, changes in methodology or opening adjustments that are not explained. Thirty-one of the 37 firms report some items of this nature. They amounted to £1,447m of changes that were positive (i.e., increasing the firm's capital), and £903m of changes that were

negative. The net outcome was a positive change of £544m. To put this in context, total liabilities at the end of 2004 were £384,214m, with capital of £25,410m.

Some insurers had particularly marked changes. One firm with capital of £696m at the end of 2004 had a change in its model that increased its capital by £251m and a further £35m from a change in the way policies were grouped into model points. Another had a model change that increased its capital by £214m. Other examples were a £90m gain from correcting an error in the tax treatment of asset shares, a reduction of £156m in capital as a result of improvements to the stochastic model code, and a reduction of £104m for what was termed "an evolving approach to the calculation of asset shares." Some of the changes may have been the result of changes to incorporate management actions. However, the examples throw doubt on the reliability to be placed on the calculations. Clearly there is concern that changes on this scale have occurred, and it is to be hoped that the regime settles down, with fewer such changes in the future.

7. CONCLUSIONS

The U.K. participating life insurance sector has experienced a radical change in its financial reporting. It has taken a tremendous effort by the regulator, the industry and the actuarial profession to make these changes.

The modelling that life insurers have carried out is far more sophisticated than what they had done previously. What insurers are doing is:

- Using stochastic models to generate economic scenarios; calibrated to the market prices of options where possible, and then used to estimate a market-consistent value of the guarantees and options that they have granted;
- Applying this to a model of the business based on model points, which have to be chosen to represent the business appropriately; and
- Where possible, including management actions in the modelling.

The development of market-consistent models has also helped life insurers:

- Make the calculations needed on new rules on minimum capital requirements, introduced by the FSA;
- Understand the finances of their business more fully; and
- Recognise, more meaningfully, their liabilities under guarantees and options, and assist in managing the risks that they present.

Nevertheless, there remains more work to do. In particular, we see the following challenges:

- What economic scenario generator a life insurer uses can make a significant difference to the way it values its guarantees and options: more work is needed to understand (and, perhaps, reduce) these differences;
- Many insurers need to extend their models to incorporate “management actions”; and
- Further controls are needed so that we do not see a continuation of the errors that arose when the new regime was introduced.

- The author also suggests some aspects of the rules that FSA should address.

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APPENDIX 1: PARTICIPATING BUSINESS

This appendix describes the operation of participating policies in more detail.

Many participating policies are endowment insurances. This would commonly be a 25-year policy (typically sold to an individual, say aged 30). Premiums are paid monthly, and the benefit under the policy is a sum insured payable at the maturity date of the policy or on the death of the life insured, if that takes place earlier. The sum insured is a guaranteed amount which would generally be not much more than the premiums payable on the policy without interest. However, as the policy participates in the profits of the insurer, the actual amount payable is expected to be higher, as a result of bonuses (dividends in U.S. terminology) being added to the guaranteed benefit.

Bonuses are of two types. First, there are annual reversionary bonuses, i.e., payable at the time of claim, representing an annual increase in the amount that is guaranteed. Second is a terminal bonus, determined at the maturity date, and intended to ensure that the total payout is at the desired level (terminal bonuses may also be payable on death and surrender).

The desired payout is typically about equal to the (smoothed) asset share of the policy. The asset share is the share of the assets of the fund that is attributable to the policy and is the premiums accumulated at the investment return achieved, less relevant outgoings. The

investment return is the total return on the assets, including realized and unrealized capital gains as well as investment income. The asset share is therefore the share of the fund's assets at market value (and is not a historic cost measure). The asset share is calculated as (AS_t = asset share at time t):

$$AS_0 = 0,$$

$$AS_{t+1} = AS_t + P_t + I_t - G_t - X_t - C_t - T_t - F_t$$

where P = premiums, I = investment return, G = charges for guarantees, etc, X = expenses, C = claims, T = taxes, F = transfers of profit to shareholders.

The asset share is a market value measure and varies daily in line with market movements. However, the desired payout is the smoothed asset share, so that when asset values are relatively high, the smoothed asset share and payout will be somewhat less than the asset share, and when asset shares are relatively low, payments will exceed asset share. Rates of terminal bonus, once decided, will typically be left unchanged for some time, perhaps a year, although the rates can be changed if market movements make it appropriate.

In accordance with the smoothing process, the life insurer sets aside monies when market values are high (by paying less than asset share to policies maturing then) to enable it to pay more than asset share when market values are low. However, a possible problem is that the guaranteed amount may exceed the asset share at the maturity date. In theory, an

insurer can reduce the probability of this happening by not declaring any annual bonuses at all. However, in practice, this is unsatisfactory for the policyholder and insurers typically declare an annual bonus such that the guaranteed benefit expected to be built up by the maturity date is unlikely to exceed the asset share. Setting annual and terminal bonus calls for judgement by the directors of the life insurer, and they will consult their actuary before coming to a conclusion.

Pension policies operate on a similar basis to endowment insurances, except that the benefit on death may be merely a return of the premiums paid or the accumulated fund. However, many life insurers have offered guaranteed annuity options, i.e., the cash payout at maturity can be converted into an annuity at a rate guaranteed when the policy commenced. Such guaranteed annuity options have proved valuable, given the increases in life expectancy and reductions in interest rates.

It is common for insurers to have the majority of the assets in respect of participating business invested in equity and property, with the remainder in bonds and cash. This constitutes significant investment risk: if, instead, assets were chosen to match liabilities, then there would be a much higher proportion of bonds. However, with-profits life insurers have typically had a substantial surplus of assets over liabilities, which can be used to justify their not matching assets to liabilities.

APPENDIX 2: RULES FOR MARKET-CONSISTENT VALUATION OF ASSETS AND LIABILITIES

Developing the rules

In 2001 a new regulator, the Financial Services Authority (FSA), took responsibility for a wide range of financial services firms, including both insurers and banks. It was natural for FSA to consider whether one regulatory approach could be used for all such firms. FSA (2001) therefore proposed that firms should have at least a minimum amount of capital that depended on the risks a firm was taking. However, it would not be satisfactory to combine a risk-based capital requirement with an "artificial" net premium valuation. The market-consistent approach was developed in response to this.

FSA felt it made more sense to have a realistic valuation of the liabilities reflecting, in particular, the constructive obligation to pay future bonuses. A realistic regime would also recognise guaranteed annuity options, and indeed guaranteed benefits on maturity, consistent with how capital markets would value them.

Market-consistent value of assets

The adjustments to the regulatory value of assets, to produce a market-consistent value are:

- Where there are inadmissible assets because the assets exceed the maximum that can be admitted, the value of the excess is included;
- Shares held in subsidiaries: the (prudent) regulatory value is replaced by market value;
- Derivatives and quasi-derivatives had a regulatory value at below market value, and this is adjusted;
- Insurers could take credit, in the traditional solvency valuation, for future profits as an "implicit item," this being allowed because the rules were designed on a prudent basis; only a minority of firms took advantage of this facility, but it is not permitted in the realistic valuation;
- An item added is the present value of future profits (or losses) from non-participating policies written in the fund: this is an asset available to support the participating business.

The major actuarial issue is the last item above, i.e., the value of future profits on non-participating policies. Insurers must use a methodology and assumptions which:

- Are based on current estimates of future experience;
- Involve reasonable (but not excessively prudent) adjustments to reflect risk and uncertainty;
- Allow for a market-consistent valuation of any guarantees or options;
- Are derived from current market yields; and
- Have regard to generally accepted actuarial practice and generally accepted industry standards appropriate for long-term insurers.

In some cases the insurer's shareholders are providing additional support to the participating funds. When such "support arrangement assets" are added to the realistic value of assets, this gives the total of "available assets."

Market-consistent valuation of liabilities

This comprises the following items, which we go on to consider in further detail:

- The with-profits benefits reserve;
- Future policy related liabilities; and
- Realistic current liabilities

With-profits benefits reserve

This is the basic liability under policies, which we can think of as the sum of asset shares. Since, typically, the insurer makes a payment at maturity about equal to the asset share, it is logical to regard its liability at some earlier date as the asset share as accrued to that date, together with a provision for guarantees, etc.

There are some types of policy where firms may not calculate asset shares. For example, this may be the case for paid up-policies, where the record of premiums paid may not be available (the insurer may not need asset shares on paid-up policies to determine the bonus rates that apply to them as it may use the same bonus rates as apply to premium-

paying policies). In such circumstances a firm may therefore use a prospective basis to calculate the with-profits benefits reserve. If it does so, the rules require that the firm must value the cashflows "using best estimate assumptions of future experience, having regard to generally accepted actuarial practice and taking into account the firm's PPFM and its regulatory duty to treat its customers fairly." The calculation will usually be on a deterministic basis and will include not only guaranteed benefits but also future bonuses at a level consistent with the firm's duty to treat policyholders fairly. This is a prospective calculation method, requiring a set of future experience assumptions, as distinct from the retrospective method of aggregating asset shares.

Future policy-related liabilities

The future policy-related liabilities fall into several categories, explained below.

Past miscellaneous surplus (or deficit) planned to be attributed to the with-profits benefits reserve

Miscellaneous surplus is, for example, surplus arising on surrenders or on non-participating business. Some insurers will automatically credit this to the asset shares of participating policies as it arises; however, if such surplus has arisen but has not yet been (but is expected to be) credited to asset shares, it is included under this heading. Similarly, if there are losses yet to be charged to asset shares, these are included here.

Planned enhancements to the with-profits benefits reserve

Insurers may intend to pay policyholders more than the ordinary calculation of the with-profits benefits reserve implies. For example, if firms have typically made payouts on maturity in recent years that exceed asset share, they may intend to pay somewhat more than asset share for maturities in the next few years. The cost of such enhancements is provided for under this heading.

In 2005, the U.K. actuarial profession issued guidance, indicating that where a participating fund was closed to new business, then it would ordinarily be expected that the surplus of realistic assets over realistic liabilities would be distributed to policyholders over time, thereby exhausting the fund in due course. This surplus should therefore be added to the realistic liabilities as calculated, thereby equating the assets and liabilities. The author comments that, in stock firms, 10 percent of this surplus would ordinarily be payable to shareholders, and this part would more appropriately be included with the "other long-term liabilities" referred to below.

Planned deductions for the costs of guarantees, options and smoothing from the with-profits benefits reserve

Where firms make such charges, they must take credit for them under this heading.

Planned deductions for other costs deemed chargeable to the with-profits benefits reserve

Firms must take credit for such charges, where they are made.

Future costs of contractual guarantees (other than financial options)

Firms must make provision for the cost of paying guaranteed benefits that exceed the with-profits benefits reserve, for example guaranteed sums insured on death, surrender or maturity. Firms are required to calculate the costs of guarantees, options and smoothing using one or more of the following three methods:

(a) a stochastic approach using a market-consistent asset model;

(b) using the market costs of hedging the guarantee or options;

(c) a series of deterministic projections with attributed probabilities.

Future costs of non-contractual commitments

An example is that, in some cases, firms have made statements to policyholders indicating that they would be able to exercise an option notwithstanding that the conditions in the policy for such option being available have not been met. The cost of this commitment must be accounted for.

Future costs of financial options

This includes the cost of guaranteed annuity options, valued as referred to above.

Future costs of smoothing

Firms must make provision for the cost of smoothing payouts, where the firm expects that claims paid will vary from the greater of the value of guarantee and the with-profits benefits reserve (increased as appropriate by any planned enhancements).

Financing costs

When the solvency position of a number of firms deteriorated in the late 1990s, some entered into a financing arrangement (loan or reinsurance), where payments to the lender or reinsurer were not required if the firm was unable to meet its obligations to policyholders and hold the minimum solvency margin. This meant that, in the traditional solvency valuation, no liability to the lender or reinsurer needed to be established. The FSA had concerns that such financial engineering might mean that firms were producing financial statements that may be misleading. In the realistic valuation, a firm has to include the value of its obligations under a financing arrangement if it estimates that, in practice, it will have to make payments to the lender or reinsurer.

Where a firm does not expect to repay the whole of its liability under a financing arrangement, it should include only its liability for the amount it expects to repay. The amount of the liability must be assessed on a market-consistent basis.

Other liabilities required for the firm to fulfil its regulatory duty to treat customers fairly

Other long-term insurance liabilities

This includes miscellaneous long-term liabilities not provided for elsewhere—for example, the cost of compensating policyholders who have been mis-sold policies, where that compensation has not yet been paid.

This item also includes, in the case of stock firms, the cost of amounts payable to shareholders corresponding to accrued bonuses in respect of liabilities provided for elsewhere. However, many firms, when listing the items included under this heading, do not refer to payments to shareholders corresponding to accrued bonuses, which it is understood firms often include in the with-profits benefits reserve. There may also be cases where a firm includes transfers to shareholders in respect of bonuses expected to be declared on existing policies but where these have not yet accrued: this, however, is a liability attributable to the future rather than being a liability at the balance sheet date. The author suggests this is an area for the regulator to review, and it would be beneficial if amounts expected to be payable to shareholders, and tax thereon, were identified separately (under this heading) from amounts expected to be payable to policyholders.

Realistic current liabilities

The realistic current liabilities are liabilities not arising under long-term insurance policies, e.g., tax and unpaid commission. These liabilities are ordinarily provided for at face value in the insurer's financial statements. However, the liabilities here need to be assessed on a "best estimate" basis; in particular, where there are future tax payments, a discounted value is used in the realistic valuation.

There is an area that is not satisfactory: FSA does not require the calculation of the insurer's liabilities under its staff pension scheme to be realistic. The author feels that the FSA should review this. However, it is acknowledged that the most appropriate way of accounting for pension scheme liabilities is a matter of debate.

A note on prudence in the valuation of liabilities

In contrast to the traditional way of calculating liabilities, the rules indicate that there is no requirement to include margins for adverse deviation of relevant factors in calculating the realistic value of the liabilities. Assumptions need be no more prudent than is necessary to achieve a best estimate, taking into account the firm's PPFM and its regulatory duty to treat its customers fairly. However, the wording ("need be no more prudent than is necessary …") does not rule out some element of prudence being included. That may lead to inconsistencies in the way in which the rules are interpreted,

and the author's view is that the rules should be reviewed to rule out the deliberate use of prudent margins to overstate liabilities.

One area where firms may introduce a deliberate margin for prudence is to avoid an understatement of the liabilities as a result of uncertainty, for example, in the firm's method or data. It is understandable that the regulator has such a rule. However, the author's view is that it would be helpful if firms disclosed where this was the case. The rules also permit appropriate approximations or generalisations where they are likely to provide the same, or a higher, result than a separate calculation for each contract. Again, the author believes that such approaches should not be used to overstate liabilities and that if they are used in a way that includes a margin, firms should state that this is the case.

APPENDIX 3: MINIMUM CAPITAL REQUIREMENTS

The new FSA rules introduce not only a different approach to valuing assets and liabilities, but also new rules on setting the minimum solvency margin. This is based on "stress tests," meaning that firms have to assess their financial position in changed financial circumstances, and hold capital that corresponds to the adverse impact on the insurer of those changed circumstances.

Stress tests are one of four approaches to setting the minimum solvency margin for insurers, as described by KPMG (2002). It is the first of those methods, the fixed ratio approach, which has been used in the European Union since minimum solvency requirements were introduced for life business in 1983. Briefly, life insurers must maintain a margin of solvency (admissible assets minus liabilities) at least equal to a minimum, which is calculated as 4 percent of liabilities plus 0.3 percent of the capital at risk upon death. The 4 percent factor is reduced for certain contract types, indeed to zero for unit-linked policies where the contract contains no guarantees about investment performance or expenses. While the rules are inevitably somewhat more complex than this very brief description, the fixed ratios approach remains very broad brush, and does not identify insurers running high risks as a result of their asset choice or nature of their liabilities; it has therefore been widely criticised as inadequate.

KPMG goes on to describe the second solvency approach as risk-based capital. This is well-known in the United States, and indeed U.K. non-life insurers have been subject to a similarly calculated minimum solvency margin since the end of 2004.

For participating life business, however, the FSA has taken the third of the approaches described by KPMG, namely using stress tests. The tests, effective from 31 December 2004, require the major with-profits life insurers to assess the amount of capital they need to cover the adverse effects of alternative scenarios. This is an explicit required solvency margin, referred to as the "risk capital margin." However, the traditional European Union rules remain in force, and firms have to retain the higher of the amounts demanded by the old and the new regime. This can lead to some difficulties, as a firm's management actions could lead to a change in which one of the two regimes leads to the greater capital requirement.

The new tests cover a limited number of risks (O'Brien, 2006): market risk, credit risk and persistency risk (i.e., the risk that policyholders will discontinue their policies at a rate different from that assumed). Briefly, the market risk test involves considering the financial position of the firm if the market value of equities rose or fell by 20 percent (less than 20 percent if share values have been falling); property values rose or fell by 12.5 percent; and the yield on fixed-securities rose or fell by 17.5 percent (e.g., by 87.5 basis points if the bond yield is 5 percent). The credit risk scenario is that the spread of yields on bonds and debt, over government bonds, is increased, more so for bonds with low credit ratings. The persistency risk scenario is that there is a change of 32.5 percent

in the rates at which policies terminate by surrender, etc. Insurers then calculate the risk capital margin as the amount needed to cover the risk in the most demanding of the stress test scenarios. If the firm has an investment strategy that hedges its market risks, the risk capital margin would be relatively low. The margin can also be reduced and, in some cases eliminated, if the firm is able to use management actions, such as cutting bonus rates.

For each firm, in both 2004 and 2005, a fall in equity and property prices was more onerous than a rise. In the case of interest rates, in 2004, a fall in yields was more onerous for 33 firms, a rise for five firms. In 2005, a fall was onerous for 30 firms, a rise for five firms (for two firms, the position was unclear).

Firms report the increase in the average spread on corporate bonds as a result of applying the stress tests. In 2005 the mean was 50 basis points, with a minimum of 12 and a maximum of 127.

Firms are required to disclose the percentage change in the realistic value of their liabilities, arising from the persistency stress test. Some firms do not provide the information precisely in accordance with the FSA rules; for those that do, in 2005, the mean effect was a 0.68 percent increase in liabilities, with a maximum of 2.4 percent. Many firms find that the onerous scenario is an increase rather than a decrease in persistency, which means more policies reaching maturity, leading to increased costs for guarantees. One firm appears to show the persistency stress test reduces the value of

liabilities; the author's view is that this is rather odd, since it does not seem to be testing an onerous scenario.

In total, the risk capital margins were £11,398m in 2004, £9,707m for 2005. This represented 2.97 percent and 2.31 percent respectively of the realistic value of liabilities. The reduction in 2005 reflected partly the strong investment returns in the year, which has reduced the likelihood of guarantees biting. However, it also reflects the new stress tests having heightened insurers' awareness of risks, and the actions that can be taken to mitigate their effect. Indeed, in 2005, 10 of the 37 firms had a risk capital margin of zero.

For completeness, we briefly mention the fourth approach to minimum solvency margins, being probabilistic modelling. The Financial Services Authority has also introduced this as a requirement for all U.K. life and non-life insurers, effectively requiring them to estimate the amount of capital they need in order to be solvent in a year's time, with a 99.5 percent probability. This is termed "Individual Capital Assessment" by the FSA, although it is beyond the scope of this paper to consider it.

APPENDIX 4. OVERALL RESULTS OF INSURERS' REALISTIC BALANCE SHEETS

Table 1. Composition of realistic value of assets

	2004	2005
	£m	£m
	400,407	437,891
Minus implicit items allocated to the fund	-892	-311
Minus value of shares in subsidiaries held in fund (traditional valuation)	-819	-983
Excess admissible assets	264	230
Present value of future profits (losses) on non-participating contracts	9,007	9,706
Value of derivatives and quasi-derivatives not reflected above	11	14
Value of shares in subsidiaries (realistic)	1,646	1,851
Realistic value of assets of fund	409,624	448,398
Support arrangement assets	1,805	2,129
Assets available to fund	411,430	450,527
Realistic value as % of regulatory value of assets	102.30%	102.40%
Maximum value	109.93%	114.02%
Minimum value	99.02%	100.00%

Table 2. Composition of realistic value of liabilities

	2004	2005			
	£m	£m	% WPBR		
			average	min	Max
With-profits benefits reserve (WPBR)	337,321	355,674			
Past miscellaneous surplus attributed to WPBR	1,851	1,896	0.53%	0.00%	10.67%
Minus past miscellaneous deficit attributed to WPBR	-118	-68	-0.02%	-1.25%	0.00%
Planned enhancements to WPBR	2,250	6,092	1.71%	0.00%	12.91%
Minus planned deductions for guarantees, options and smoothing from WPBR	-8,162	-7,763	-2.18%	-8.07%	0.00%
Minus planned deductions for other costs chargeable to WPBR	-3,541	-3,720	-1.05%	-6.47%	0.00%
Future costs of contractual guarantees (other than financial options)	19,573	19,206	5.40%	0.00%	22.79%
Future costs of non-contractual commitments	1,656	1,861	0.52%	0.00%	3.73%
Future costs of financial options	8,540	10,602	2.98%	0.00%	18.80%
Future costs of smoothing (possibly negative)	1,354	112	0.03%	-2.86%	2.23%
Financing costs	753	794	0.22%	-2.60%	14.42%
Any other liabilities related to regulatory duty to treat customers fairly	24	25	0.01%	0.00%	1.21%
Other long-term insurance liabilities	7,234	7,927	2.23%	0.00%	8.57%
Total future policy-related liabilities	31,413	36,965	10.39%	-0.70%	31.93%
Realistic current liabilities of the fund	15,480	27,295	7.67%	-0.02%	30.28%
Realistic value of liabilities of fund	384,214	419,933	118.07%	103.27%	150.56%

APPENDIX 5: ASSUMPTIONS USED BY INSURERS

Table 3. Assumptions for assessing value of non-participating business

		Mean	min	max	s.d.	no. of firms
Investment return	2004	4.66%	4.25%	5.00%	0.17%	26
	2005	4.18%	3.50%	4.50%	0.17%	26
Expense inflation	2004	3.70%	2.50%	5.50%	0.68%	23
	2005	3.75%	2.50%	5.50%	0.70%	22
Discount rate	2004	6.55%	4.46%	8.00%	1.22%	27
	2005	5.87%	4.04%	8.00%	1.21%	26

Notes: (1) where an insurer used a term-dependent yield, the 10-year rate has been used; (2) there were no statistically significant correlations between the variables in the table.

Table 4. Assumptions in prospective calculation of with-profits benefits reserve

		Mean	min	max	s.d.	no. of firms
Investment return	2004	5.27%	4.50%	7.00%	0.82%	13
	2005	4.94%	3.92%	7.07%	0.99%	15
Expense inflation	2004	3.90%	2.50%	6.00%	0.93%	18
	2005	3.97%	2.75%	6.80%	1.09%	19
Discount rate	2004	5.14%	4.00%	7.00%	0.79%	18
	2005	4.79%	3.70%	7.00%	0.94%	21

APPENDIX 6: ECONOMIC SCENARIO GENERATOR RESULTS

We begin by setting out the risk-free rates that firms have used in 2005, for terms of 5, 15, 25 and 35 years. We show the information according to whether insurers were financially strong or weak, and according to the model used.

Table 5. Risk-free rates

	Term (years)			
	5	15	25	35
Mean				
BH	4.28%	4.19%	4.08%	3.97%
TSM	4.24%	4.13%	4.05%	3.98%
Other				
Total	4.28%	4.18%	4.07%	3.98%
Weak firms	4.28%	4.18%	4.07%	3.97%
Strong firms	4.28%	4.18%	4.08%	3.99%
s.d.				
BH	0.025%	0.024%	0.027%	0.030%
TSM	0.040%	0.055%	0.041%	0.051%
Other	0.021%	0.037%	0.062%	0.082%
Total	0.036%	0.049%	0.045%	0.054%
Min (all firms)	4.19%	4.09%	3.91%	3.78%
Max (all firms)	4.34%	4.28%	4.14%	4.12%
No. of firms				
BH	16	16	16	16
TSM	9	9	9	8
Other	11	11	11	11
Total	36	36	36	35

Note: weak (strong) firms are those with lower (higher) financial strength than average. Financial strength is measured by the ratio of realistic assets to realistic liabilities (excluding liabilities arising in closed funds from future distributions of surplus). One firm had a year-end date of 14 January rather than 31 December, which led to a lower risk-free rate being used.

We can see from the following table of correlations that firms that have a relatively low risk-free discount rate for a five-year term tend to have a low rate at other terms, and so on. The table shows the correlation coefficient, significance level (p-value) and number of observations.

Table 6. Correlations between risk-free rates

	5	15	25
5			
15	0.8477 0.0000 36		
25	0.7280 0.0000 36	0.7693 0.0000 36	
35	0.523 0.0011 35	0.5304 0.0010 35	0.8851 0.0000 35

We now set out the option prices for the four categories of asset (equities, property, risk-free bonds and corporate bonds), with n = 5, 15, 25, 35, in each case with K = 1.00 (i.e., at-the-money). The tables show the means, coefficient of variation and minimum and maximum.

Table 7. Option prices: equities

	Term (years)			
	5	15	25	35
Mean				
BH	170,200	329,914	441,957	532,239
TSM	160,472	293,061	395,316	469,856
Other	158,028	275,598	366,600	441,117
Total	164,221	304,919	408,433	490.760
Weak firms	160,755	300,110	399,690	479,570
Strong firms	168,337	310,629	418,816	503,348
C.V.				
BH	11.3%	8.2%	12.1%	13.3%
TSM	1.7%	3.1%	4.3%	6.1%
Other	9.3%	12.8%	14.4%	15.8%
Total	9.7%	11.6%	13.8%	15.1%
Min (all firms)	140,252	227,343	308,416	370,131
Max (all firms)	218,189	390,254	553,575	678,282
No. of firms				
BH	16	16	16	16
TSM	9	9	9	8
Other	10	10	10	10
Total	35	35	35	34

Table 8. Option prices: property

	Term (years)			
	5	15	25	35
Mean				
BH	132,951	233,523	310,103	383,682
TSM	121,317	228,556	321,983	415,482
Other	128,451	226,163	302,449	387,696
Total	128,983	230,016	312,339	391,024
Weak firms	127,053	227,637	310,396	390,313
Strong firms	131,299	232,871	314,670	391,830
C.V.				
BH	2.0%	2.3%	3.8%	5.6%
TSM	10.2%	11.8%	12.8%	2.3%
Other	5.4%	6.0%	5.7%	5.4%
Total	6.3%	6.4%	7.2%	5.8%
Min (all firms)	95,851	173,895	240,921	344,475
Max (all firms)	138,877	261,146	368,015	433,071
No. of firms				
BH	15	15	15	15
TSM	7	7	7	6
Other	11	11	11	11
Total	33	33	33	32

Table 9. Option prices: 15-year risk-free zero coupon bonds

	Term (years)			
	5	15	25	35
Mean				
BH	61,187	76,385	90,939	134,680
TSM	71,517	73,430	88,824	118,316
Other	58,374	67,629	75,150	114,185
Total	62,910	72,971	85,586	124,498
Weak firms	61,540	69,656	80,966	121,835
Strong firms	64,622	77,114	91,361	127,660
C.V.				
BH	10.9%	34.0%	42.5%	23.9%
TSM	9.9%	4.1%	7.4%	9.9%
Other	4.3%	5.7%	4.8%	5.2%
Total	12.2%	24.1%	31.0%	19.4%

Min (all firms)	55,396	60,588	66,153	94,522
Max (all firms)	63,226	128,710	168,549	198,955
No. of firms				
BH	16	16	16	16
TSM	9	9	9	8
Other	11	11	11	11
Total	36	36	36	35

Table 10. Option prices: 15-year corporate bonds

	Term (years)			
	5	15	25	35
Mean				
BH	71,523	101,033	125,289	166,995
TSM	74,508	79,740	98,801	130,433
Other	64,920	82,917	93,339	132,164
Total	70,778	91,127	110,770	149,762
Weak firms	69,089	89,041	106,890	147,218
Strong firms	73,696	94,732	117,472	153,925
C.V.				
BH	15.4%	29.3%	33.4%	23.7%
TSM	9.1%	21.2%	22.6%	17.1%
Other	2.3%	6.8%	8.9%	11.3%
Total	12.9%	26.9%	31.3%	23.8%
Min (all firms)	63,151	72,418	84,612	108,170
Max (all firms)	92,486	158,151	205,682	242,669
No. of firms				
BH	15	15	15	15
TSM	8	8	8	7
Other	7	7	7	7
Total	30	30	30	29

Option prices are also given for three portfolios, which will reflect insurers' assumptions about correlations in returns:

- Portfolio 1: 65% equity, 35% property
- Portfolio 2: 65% equity, 35% risk-free zero coupon bonds
- Portfolio 3: 40% equity, 15% property, 22.5% 15-year risk-free coupon bonds, 22.5% 15-year corporate bonds.

These portfolios are examples of the investment strategies adopted by participating funds, although some weaker funds will be invested largely in bonds.

Table 11. Option prices: Portfolio 1

	Term (years)			
	5	15	25	35
Mean				
BH	132,275	253,485	344,703	443,861
TSM	130,699	249,346	348,861	428,247
Other	123,516	216,868	296,264	367,939
Total	129,287	241,511	330,906	417,208
Weak firms	128,634	241,004	328,553	403,046
Strong firms	130,069	242,120	333,731	433,258
C.V.				
BH	12.7%	9.2%	12.1%	17.1%
TSM	6.2%	4.7%	3.9%	4.4%
Other	11.1%	12.0%	12.9%	13.7%
Total	10.6%	11.3%	12.8%	16.5%
Min (all firms)	111,184	177,671	252,831	314,656
Max (all firms)	179,600	308,669	415,555	650,192
No. of firms				
BH	16	16	16	16
TSM	7	7	7	6
Other	10	10	10	10
Total	33	33	33	32

Table 12. Option prices: Portfolio 2

	Term (years)			
	5	15	25	35
Mean				
BH	118,614	228,449	311,758	387,226
TSM	100,196	185,632	263,886	323,526
Other	107,839	184,163	249,791	309,856
Total	110,799	204,786	281,744	349,482
Weak firms	108,569	201,369	274,821	340,146
Strong firms	113,448	208,843	289,964	359,986
BH	12.7%	7.5%	10.7%	12.1%
TSM	4.1%	1.8%	4.9%	7.0%
Other	8.4%	13.2%	14.7%	16.4%
Total	12.3%	13.6%	14.6%	16.0%
Min (all firms)	95,236	150,997	210,643	259,441
Max (all firms)	149,027	263,336	380,946	491,594
No. of firms				
BH	19	19	19	19
TSM	9	9	9	8
Other	10	10	10	10
Total	35	35	35	35

Table 13. Option prices: Portfolio 3

	Term (years)			
	5	15	25	35
Mean				
BH	89,053	165,012	227,877	291,059
TSM	72,604	137,259	210,659	271,623
Other	78,459	134,631	184,324	237,545
Total	82,525	150,980	213,208	273,516
Weak firms	81,362	155,916	224,225	287,053
Strong firms	84,736	148,381	207,410	265,995
C.V.				
BH	13.8%	8.7%	10.9%	10.8%
TSM	9.5%	7.8%	5.2%	3.1%
Other	9.4%	15.2%	16.1%	16.4%
Total	14.8%	13.8%	13.6%	13.5%
Min (all firms)	66,603	106,605	156,672	204,932
Max (all firms)	106,158	180,433	263,618	350,991
No. of firms				
BH	15	15	15	15
TSM	7	7	7	6
Other	7	7	7	7
Total	29	29	29	28

Tables 14 to 17 show the variation in put option prices by K for various terms and assets. K = 0.75 is out-of-the-money, 1.0 is at-the-money, 1.5 is in-the-money.

Table 14. Option prices: 5-year term, by moneyness

	Mean			C.V.		
K	0.75	1.0	1.5	0.75	1.0	1.5
Equities	53,510	164,221	542,444	19.5%	9.7%	2.7%
Property	29,063	128,983	520,877	18.1%	6.3%	0.8%
Risk-free bonds	4,065	62,910	500,105	68.1%	12.2%	0.2%
Corporate bonds	6,507	70,778	501,553	52.1%	12.9%	0.5%
Portfolio 1	29,963	129,287	520,636	27.6%	10.6%	1.9%
Portfolio 2	19,462	110,799	512,784	43.3%	12.3%	1.3%
Portfolio 3	7,764	82,525	503,799	60.4%	14.8%	0.5%

Table 15. Option prices: 15-year term, by moneyness

	Mean			C.V.		
K	0.75	1.0	1.5	0.75	1.0	1.5
Equities	161,480	304,919	674,809	19.7%	11.6%	5.3%
Property	98,710	230,016	603,289	12.4%	6.4%	2.1%
Risk-free bonds	9,729	72,971	500,063	70.3%	24.1%	1.5%
Corporate bonds	17,476	91,127	504,053	67.8%	26.9%	2.8%
Portfolio 1	109,395	241,511	610,926	20.6%	11.3%	4.3%
Portfolio 2	79,229	204,786	579,654	32.9%	13.6%	3.8%
Portfolio 3	41,726	150,980	535,906	42.0%	13.8%	2.7%

Table 16. Option prices: 25-year term, by moneyness

	Mean			C.V.		
K	0.75	1.0	1.5	0.75	1.0	1.5
Equities	245,921	408,433	792,719	19.8%	13.8%	7.6%
Property	162,559	312,339	689,376	12.1%	7.2%	3.5%
Risk-free bonds	12,092	85,586	507,142	106.4%	31.0%	3.1%
Corporate bonds	25,401	110.770	516,356	83.7%	31.3%	5.3%
Portfolio 1	180,538	330,906	706,812	19.4%	12.8%	6.4%
Portfolio 2	137,934	281,744	659,919	27.0%	14.6%	5.9%
Portfolio 3	84,067	213,208	591,902	29.4%	13.6%	4.6%

Table 17. Option prices: 35-year term, by moneyness

	Mean			C.V.		
K	0.75	1.0	1.5	0.75	1.0	1.5
Equities	314,270	490,760	889,858	20.2%	15.1%	9.2%
Property	227,989	391,024	775,520	7.9%	5.8%	3.8%
Risk-free bonds	22,931	124,498	528,756	72.1%	19.4%	3.5%
Corporate bonds	42,547	149,762	545,877	60.3%	23.8%	5.9%
Portfolio 1	243,611	417,208	793,741	18.9%	16.5%	7.7%
Portfolio 2	192,708	349,482	735,595	25.2%	16.0%	7.8%
Portfolio 3	130,617	273,516	653,227	23.2%	13.5%	5.9%

Table 18. Correlation between 15-year option prices with differing moneyness

	K = 0.75 & K = 1	K = 1 & K = 1.5	K = 0.75 & K = 1.5
FT-All Share Index	0.9869 0.0000 35	0.9746 0.0000 35	0.9278 0.0000 35
Property	0.9908 0.0000 33	0.9531 0.0000 33	0.9076 0.0000 33
15-year risk-free zero coupon bonds	0.8142 0.000 36	0.7979 0.0000 36	0.5511 0.0005 36
15-year corporate bonds	0.9486 0.0000 30	0.8359 0.0000 30	0.7098 0.0000 30

Lastly, we look at receiver swaptions with a strike rate of 5 percent, exercisable n years after the valuation date with swap duration on exercise (L) of 20 years.

Table 19. Prices of: Receiver swaptions: L = 20

	n (years)			
	5	15	25	35
Mean				
BH	13.1%	12.1%	10.1%	8.2%
TSM	13.5%	11.2%	8.0%	5.2%
Other	12.0%	10.2%	8.8%	6.7%
Total	12.9%	11.3%	9.2%	6.9%
Weak firms	13.0%	11.6%	9.1%	7.0%
Strong firms	12.8%	10.9%	9.3%	7.2%
C.V.				
BH	8.2%	5.3%	13.0%	22.6%
TSM	7.0%	4.8%	4.5%	7.8%
Other	7.7%	30.7%	9.0%	11.5%
Total	8.9%	17.0%	14.3%	30.9%
Min (all firms)	10.4%	1.1%	7.3%	4.6%
Max (all firms)	16.7%	13.3%	12.3%	11.6%
No. of firms				
BH	16	16	16	16
TSM	9	9	8	7
Other	11	11	11	11
Total	36	36	35	34

Table 20. Assumed correlations between asset classes

			mean	min	max	s.d.	no. of firms
Equities	Property	2004	0.25	0.05	0.55	0.10	24
		2005	0.26	0.14	0.55	0.08	25
Equities	Gilts	2004	0.27	0.05	0.53	0.20	11
		2005	0.24	-0.11	0.53	0.24	11
Equities	Corp bonds	2004	0.36	-0.09	0.48	0.16	13
		2005	0.32	-0.06	0.48	0.16	12
Property	Gilts	2004	0.09	0.06	0.20	0.04	10
		2005	0.04	-0.08	0.13	0.06	11
Property	Corp bonds	2004	0.11	0.00	0.29	0.09	12
		2005	0.08	-0.03	0.29	0.10	11
Equities	Cash	2004	0.10	-0.20	0.40	0.14	11
		2005	0.05	-0.24	0.11	.10	11
Property	Cash	2004	-0.02	-0.33	0.20	0.24	9
		2005	-0.02	-0.33	0.16	0.22	10
Gilts	Cash	2004	0.19	-0.01	0.80	0.31	6
		2005	0.00	0.00	-0.63	0.30	7

Note: Some insurers reported separate correlations for U.K. equities and overseas equities; in such cases, we have used the figures for U.K. equities. In some cases, insurers gave more than one correlation coefficient between two asset classes (for example, for short-term and long-term correlations): in such cases, the average of the figures was used.

APPENDIX 7: RECOMMENDATIONS FOR THE FINANCIAL SERVICES AUTHORITY

The author recommends that the Financial Services Authority considers the following issues.

1. The rules should prohibit prudence margins being added merely for the sake of prudence; and where the margins are added as a result of uncertainty in the firm's method or data, or because of approximations or generalisations, the amount of margin (or estimated margin) added should be stated.

2. Where the planned enhancements of the with-profits benefits reserve include the allocation of surplus assets in a closed fund: in stock firms, the part of such enhancement planned to be allocated to shareholders should be attributed to "other long-term liabilities."

3. It should be clarified that the "other long-term liabilities" should include future transfers to shareholders, corresponding to accrued bonus, but not future bonuses on policies that have not yet accrued; and this item should not be included as part of the with-profits benefits reserve.

4. The insurer's liabilities for its staff pension scheme should be included on a "realistic" basis (the detail of which requires further discussion).

5. Firms should state which management actions have not been taken into account in calculating their realistic liabilities.

6. The rules should clarify what disclosure is required about correlations between asset classes.

7. The mortality assumptions should also be expressed in the form of the expectation of life.

8. FSA should examine firms' expense inflation assumptions.

9. FSA should consider the variation between firms in the put option prices they report from their ESG models.