ABSTRACT OF THE DISCUSSION

Mr T. J. Sheldon, F.I.A. (introducing the paper)**:** This paper was conceived almost a year ago, though events over the past year, in particular the publication of CP 195 by the Financial Services Authority (FSA) and the continuing challenge presented to the larger with-profits offices in preparing realistic balance sheets, have prompted us to write a rather more wide ranging paper than originally intended. While the move to a realistic, or market consistent, approach to the valuation of life assurance business for regulatory reporting has been welcomed, and there has been much discussion on the detail of CP 195, there has been relatively little debate on the reasons for adopting a market consistent valuation, what the term 'market consistent' actually means, and on the scope for discretion in the choice of both method and assumptions. Our paper explores some of these issues.

Market consistent valuation has its origins in 'mark to market' accounting, applied for many years to organisations whose primary activity is two-way trading in liquid markets. In these conditions, market prices are well defined and easily observed, making the accounting process straightforward. The long-term liabilities of life offices are not traded in an active market, and, consequently, a market consistent valuation relies on model-based valuation techniques to extrapolate from those prices which can be observed. The wide scope for management discretion in with-profits business makes this comparison even more tenuous. This fundamental difference between using market prices and using a model of market price formation results in the need, either to rely on judgement, or for clear standards and guidance.

As we point out in the first paragraph of the paper, there is no clear definition of market consistent valuation. A precise specification of the term may depend on the purpose of the valuation. Even in what might appear to be the simplest choice of a risk free rate of interest, there are several different practices. In a recent survey on realistic balance sheets carried out by our firm, half the respondents were using a gilts-based risk free curve, while the other half were using swap-based models, mostly without any yield reduction for credit risk. When we turn to assumptions for volatilities and correlations, we encounter more difficult problems, because the absence of a liquid market, or indeed any market, for some of the assets held in with-profits funds. Taxation, as always, complicates the choice of assumptions.

Several companies are now using Monte Carlo simulations to calculate their realistic liabilities, permitting allowance for management action and policyholder behaviour. These models, while complex, are useful tools, not just for valuation, but, more importantly, in testing strategies for the management of with-profits funds. There is, though, a popular misconception that the use of the Black-Scholes option pricing formula and its relatives is appropriate only for the simplest guarantees. This is not the case. While it may not be possible to calibrate a suitable option pricing formula for every type of management action, it may be possible to achieve a satisfactory fit using an exotic option formula. Such an approach may prove invaluable when projecting realistic balance sheets, or in sensitivity testing.

We have highlighted some of the difficulties in applying market consistent valuation to life assurance business. Many of these difficulties will also be encountered in the valuation of other liabilities. We also offer some practical ways forward through these difficulties. Some may regard the approach as too difficult for what will still be an imperfect method of valuation. The central question is whether market consistent valuation will enable better management of those financial institutions which we advise. In our view it will. Market consistent valuation, while not perfect, is a marked improvement on what we had before.

Mr D. C. E. Wilson, F.I.A. (opening the discussion)**:** The paper covers a lot of ground. The main focus is on deriving assumptions and formulae for market consistent valuations of life assurance business, either from a policyholder or a shareholder perspective, but it also discusses hedging of risks within the business.

One thing that the paper certainly does is dispel any lingering thoughts that market consistent valuation might be straightforward. The authors helpfully highlight a number of traps for the unwary. For example, ¶4.5.18 points out the possible importance of negative interest rate scenarios using the Hull-White model. The paper also explains some subtle effects of taxation.

The authors present a coherent and logical framework for market consistent valuation, together with a well argued rationale. However, there are occasions where theoretical niceties have won out over the practicalities of the real world. We should not forget that the major life assurers must implement the FSA's new rules in the near future. The resources of the industry are finite, and I suspect that some of the authors' refinements will have to stay in the 'too difficult' box for some considerable time.

Nor should we overstate the extent to which other financial companies already adhere to the principles discussed in this paper. Paragraph 2.4.7.5 suggests that the authors believe that banks use mark to market accounting. This is emphatically not the case with their loan books, especially problem credits. Insurers, by contrast, do mark their loans (e.g. bonds, private debt) to market, and so need to represent the long-term nature of their business on the liability side of the balance sheet.

The paper discusses several important questions which deserve comment:

(1) Should guaranteed liabilities be discounted using gilt yields or swap rates?
(2) What is the appropriate balance between accuracy of calibration of fit and likely applicability to the liabilities valued?
(3) Should options be valued using implied or historic volatilities (or, indeed, expected realised volatilities)?
(4) How can Monte Carlo simulation and formula-based valuation best be combined?

The authors start by discussing possible reasons for market consistent valuation. This is a fundamental issue, which will affect the answers to some of the questions raised. The FSA's stated intention to make the regulation of insurers more like that of banks suggests that the authors' third reason — the desire for comparable valuations which reduce the need for subjective judgement — is paramount. The authors also rightly refer, in ¶2.3.3, to the impact that unhedged guarantees have had on the industry in recent years. Hence, a desire for a more holistic approach to risk management is also clearly a driver behind the introduction of the realistic balance sheet.

However, does this mean that insurance companies should be expected to survive a period of market dislocation, which leads to insolvencies amongst the banking sector, as seems to be implied by the authors' advocacy of the case for gilt yields rather than swaps rates? In ¶2.3.6 the paper makes the argument that market consistent valuation should contribute to ensuring financial soundness. Requiring insurers to hold sufficient assets to meet a theoretical buyout test in normal times, as well as risk-based capital to cover the likelihood of significant increases in costs during conditions of financial distress, seem to be entirely sensible. This must, generally, be a theoretical test, because there may well be no realistic opportunity for an actual buyout; but it is by no means clear that the capital should be required to meet buyout costs in distressed situations, where any buyout market might be suffering extreme dislocation.

The effect of requiring super-solvency from insurers can be seen clearly in ¶3.4.3, where the authors acknowledge that consistency in the use of gilt yields would require LIBOR linked deposits accepted by an insurer to be valued above face value. Whatever happened to the idea of a level playing field with banks? Again, in ¶3.4.2 the authors clearly suggest that, where an insurer is liable to pay cash flows under an over-the-counter derivative contract, such as a swap, then the 'market consistent' value of the liability is different from that which would apply if it was liable to pay the same cash flows under an insurance policy. This might be the intention of a regulator seeking solely to guarantee the solvency of insurance companies, but, again, does not suggest a level playing field.

The solution to these anomalies (as well as to the issues raised in ¶4.3, concerning the fact

that market values of options depend on swap rates rather than gilt rates) is to accept that swap rates should be the starting point in deriving the realistic balance sheet. The authors summarise their view, in ¶3.3.9, that: "insurance solvency supervision is most usefully implemented relative to a liability that is as close to risk free as possible." My view, in contrast, is that it should be relative to a liability that is as close to 'market consistent' as possible.

This is not to deny that most financial transactions tend to involve an element of credit risk. However, the appropriate place to allow for the credit risk inherent in derivative transactions is in the risk capital margin, as would also be the case, for example, with credit risk associated with reinsurance arrangements.

On the general question of model calibration, the paper points out that difficult decisions must be made. No model, however complex, will be able to replicate the prices of all financial instruments accurately, although it may be possible to cover a wider spread through varying the parameters in a formula-based approach than through Monte Carlo simulation. Hence, it is important to consider the nature of the liabilities that the model will be used to value, and to choose a model and calibration which is expected to produce appropriate values for these particular liabilities.

The question of the choice of volatility assumption is highlighted by the authors' example of property assets in ¶7.3.5. As the paper says, options on property are not generally available, and, if they were, then implied volatilities would almost certainly be much higher than realised historic volatilities or expected future volatilities. Does this mean that we should be inventing a high implied volatility to use, and what purpose would be served by doing so?

Similarly, the authors point out, in ¶4.6, that there is no market in the correlation between equities and fixed-interest. In fact, it is possible to get quotes on options on a combination of these assets, meaning that it is possible to derive an implied correlation, but in no way can this be called an efficient market. So, what are we to do in practice?

I agree with the authors that it is not appropriate, simply to use implied volatilities, where hedging assets have been purchased, and historic volatilities otherwise. This violates the principle that the value of the liabilities should be independent of the assets held, unless the liabilities actually depend on the performance of the assets. Although not justifiable theoretically, the pragmatic solution would seem to be to use market implied parameters, where a reasonably efficient market is thought to exist (for example, short-term equity volatility, medium-term interest rate volatility), but to use forecast parameters, probably based on historical data, where no such market exists (for example long-dated equity volatility, property volatility, correlations).

The paper includes a lot of useful ideas and formulae for valuing particular types of liabilities. For example, the concept of a 'super risky' asset, in Section 5.4, was an ingenious approach to seeking to capture the effect of a dynamic investment policy. There are also helpful references to work in other fields addressing the valuation of complex options, and there is a good discussion in Section 8 of the pros and cons of Monte Carlo simulation and closed form solutions.

As the paper points out, one of the key benefits of deriving valuation formulae is to obtain an insight into the dependence of the liability valuation on important parameter assumptions. This can be useful, even where it is recognised that the formulae are not sufficiently general to provide the basis of the valuation itself. The paper also highlights what some of those key parameters are likely to be, namely long-dated volatilities and correlations, and assumptions about future management and policyholder actions. The authors seem to play down the impact of management flexibility, suggesting, in ¶8.2.4, that such flexibility is likely to be less important today, following recent market conditions. Clearly, this will depend on the circumstances of individual offices, especially on the level of guarantees granted, including past bonuses.

The final section of the paper touches on the important topic of hedging risks in with-profits funds. The authors identify the problems that the common practice of allocating the same investment return to all asset shares introduces. They also discuss possible ways to charge for guarantees and some alternative methods of hedging.

Perhaps the most important conclusion of the paper is that reasons exist for legitimate differences of opinion over important assumptions, suggesting that the original aim of comparable valuations may be frustrated. However, we should not forget that, although there is room for significant variation in the final outcome, the whole concept of the realistic balance sheet is undoubtedly a huge step forward. It is better to be roughly right than exactly wrong.

Ms T. J. Abbey, F.I.A.: Market consistent actuarial valuations are being used more and more in actual mergers and acquisitions (M&A) transactions, particularly in the case of the sale of closed with-profits fund portfolios. While understanding the long-term nature of life insurance business, the purchaser's primary interest is in capital availability and its 'release ability'. Traditional embedded values (EVs) do not allow explicitly for the costs of options and guarantees embedded in a with-profits portfolio. The valuation also normally assumes that shareholders' transfers from life insurance business are immediately available to shareholders; that is, they discount at a rate above the next risk free rate (the risk discount rate) earned from the date of the bonus declaration, or profit distribution. Allowance is sometimes made for the cost of holding back the solvency margin until that amount is 'releasable' to shareholders.

Some companies have been producing realistic, or modified, embedded values, which have taken the first step towards trying to use a more market consistent approach, and contain an explicit valuation of the cost of market risks, such as guarantees and options. However, a market consistent valuation for M&A transaction purposes tends to differ from the latter for two main reasons. Firstly, the shareholder transfers in a realistic EV methodology tend to be the same as for a traditional EV, and do not allow for the restrictions that a regulator might apply to releases of capital; for example: a fund being in deficit; or another part of the group being in deficit or failing to meet an assumed risk capital management/individual capital assessment (RCM/ICA) required level going forward. A truer reflection of the value of a company is based on the flows of capital at the point at which they become available to the shareholders.

The second is an allowance for all the risks to which the company is subject. The realistic EV places a value on shareholder transfers allowing for market risk, and then discounts the resulting flows at a risk free rate. This does not take into account the full range of non-market risks to which the company may be subject, ranging from the often excluded more actuarial type risks, such as mortality and persistency, through to operational risks, such as regulatory change, brand reputation and systems and controls. As it is extremely unlikely that it will be possible to model all these non-financial risks explicitly, using a higher discount rate than the risk free rate can be the best proxy.

A market consistent valuation of a life company for M&A transaction purposes will tend to be on a 'capital is king' style approach, involving the discounting of capital from the date 'dividend-able' to shareholders at a rate higher than the risk free rate. The actual rate would depend on the required capital returns for the purchasers and their views of the premium to be paid for taking on the non-explicit risks. This requires a calculation of the projected realistic balance sheets for with-profits funds, projection of balance sheets for unit-linked to non-profit funds, plus the RCM/ICA capital requirements of the regulators. Excess capital above that to be required can be 'dividended' over a period, and valued at the required rate. We would not be surprised if the realistic balance sheet became a precondition of the sale of the closed with-profits fund. This demonstrates the value of the techniques in the paper for commercial transactions and internal management purposes, as well as to enable companies to meet the regulatory requirements.

Mr A. J. Bice, F.I.A.A., F.I.A.: I shall cover two areas. Firstly, on calculation techniques, the authors outline the benefits and drawbacks of closed form solutions versus simulations in Section 8, and also touch on this topic in Section 5. It would seem that the choice is between getting a good fit to market prices via closed form solutions (where the input parameters can be adjusted on a policy-by-policy basis if desired), or allowing a more detailed model of the product structures and available discretion from a simulation model, but with a poorer fit to market

prices. In practice, it is likely that both of these approaches will be used for a market consistent valuation, depending on the purpose, and I expect to see further developments in both techniques.

The authors present a number of extensions to the basic Black or Black-Scholes models, in an attempt to improve the ability of closed form solutions to fit the product structures. Unfortunately, they do not present any quantitative analysis to show how successful these extensions are. There is a danger in spending too much time over-engineering closed form solutions, to the point that we miss some more important issues, such as understanding the dynamics and drivers of value. One of the benefits of simple closed form solutions is that they are just that — simple. Their benefits and flaws can be easily understood. Additional complexity might add some incremental accuracy, but, potentially, it will make it more difficult to understand what is driving the results. There is also the danger of targeting accuracy in one area, but allowing much greater inaccuracy in other areas. Examples might be where liabilities are backed by credit risky assets, illiquid assets such as mortgages, or derivatives. Closed form solutions are likely to be far less accurate here compared to simulation, and small gains in reproducing the details of bonus policy are likely to be far outweighed by inaccuracies in these other areas. Obviously, where product structures are simple enough, or where simulation is not feasible, analytic solutions will suffice, and the authors make a case for their use when embedding future realistic balance sheets within stochastic scenarios. This, in itself, presents other modelling issues, and, to work well, we have to ensure that the projection software and models are up to the task.

However, if the impact of bonus strategy, dynamic asset mix or policyholder behaviour is the focus, or if the asset mix involves the use of credit risky assets or derivatives, I doubt that many will feel that the incremental benefit from more complex closed form solutions is worth the opacity that this brings. This will be particularly the case for product development and scenario testing of management strategies.

Secondly, the paper concentrates on the use of market consistent valuations for the point-in-time measurement of insurance liabilities. However, its benefits can be much further reaching than this. In particular, it can be used to give much greater insights to the profit dynamics of both the in-force book and new products than past methods of analysis have done. It is an extremely powerful tool. I hope that the use of market consistent valuations does not become simply an esoteric tool for the valuation actuary, but is incorporated into the broader management of insurance companies, from product design, risk and capital management, performance management, through to larger strategic decisions such as M&A. Of course, in these areas there is no reward for the laxity that the authors are so keen to find elsewhere. Instead, the rewards are in the understanding that sensible and robust use of market consistent techniques can bring. A market consistent management framework has the potential to create a much safer, more stable, more transparent and, at the same time, more profitable insurance industry, which would be to the benefit of both policyholders and shareholders.

Mr M. B. Chaplin, F.I.A.: The paper serves to highlight the significant challenges posed to the actuarial profession, the insurance industry and the regulators in achieving the aim of a more transparent, objective and comparable set of financial reporting information. Some of the uncertainties covered in the paper bring home the very real danger that a headlong rush to disclose market consistent valuations in advance of a common standard may further undermine the confidence of policyholders, equity analysts, the media and any other participants in, or commentators on, the life assurance industry. To this end, the establishment of an Actuarial Standards Board, or a comparable mechanism for imposing standards, should be expedited.

I have three specific comments on the paper:

(1) The authors make an observation that the use of dynamic decision rules tends to produce an implied volatility that decreases as policy guarantees move further out of the money. This observation is coupled with the remark that volatility skew operates in the opposite direction, and is used to draw the conclusion that, using fixed implied volatility and

dynamic decision rules, effectively double counts management action. This conclusion is flawed for two reasons: first, it is possible that the fixed implied volatility used may have been derived from an out-of-the-money option; and second, that volatility skew and management actions represent two different effects, which could have significantly different orders of magnitude.

(2) Concerning the guaranteed annuity option evaluation methodology, set out in Section 5.7, the authors put forward an argument for using an estimate of an open market annuity price to value the payoff under a guaranteed annuity option. This is offered as a better alternative to the more common approach of using the market consistent value of the annuity, that is the use of an offer price rather than the mid-market price. While I would agree with the logic of using the offer price for determining likely policyholder take-up rates for the guaranteed annuity option, using an annuity rate including margins would be inconsistent with the valuation approach, unless pricing margins are included in all the assumptions.

(3) The authors suggest a number of possible approaches and benefits to developing closed form solutions as possible alternatives to Monte Carlo simulations. While I do not doubt the benefits of having a reliable formulaic alternative to Monte Carlo simulations, and believe that the methods outlined may have some useful applications, I would disagree with the authors' remark, in ¶8.2.4, that: "bonus rates and many funds' equity contents are significantly lower, so the impact of management discretion on market consistent values of liabilities is likely to be much reduced. The benefits of Monte Carlo modelling may therefore not be so great in current conditions, compared with the simpler formula methods.''

On the contrary, our recent ALM and realistic balance sheet work, both in the United Kingdom and in Europe, where equity backing ratios are frequently lower, has shown that management discretion can still have a critical impact on the value attributed to guarantees. This is in cases, or countries, where management discretion still exists.

Fund level decision rules pose a significant obstacle to the development of representative closed form solutions. There is a danger that, in ignoring fund level decision rules such as guarantee re-charging, closed form methods can significantly overstate the cost of guarantees.

Mr D. W. Dullaway, F.I.A.: My comments focus on the issue of calibration, and, in particular, the choice of the risk free rates.

Why do we need calibration? In theory, a market consistent valuation is one that values assets and liabilities either at their market prices or, more usually, by reference to an appropriate hedging portfolio. If we put to one side diversifiable risk, this means finding the price of a portfolio of traded assets and derivative securities that exactly matches an insurance company's liabilities. The price of constructing this portfolio is the value of the liability.

At this most basic level there is no question of calibration; we simply look up the market prices in the newspaper. In practice, we do not actually do this, for two reasons. First, it would be very tedious, given the number of cash flows that we need to value; and second, we do not have ready access to all prices. Instead, we pick a model that broadly represents the behaviour of asset prices, use the market prices to calibrate the model, and then use that model to value the liabilities. However, we must remember that the model is just a short cut to finding the market prices, and, in general, has no validity on its own.

This has several important implications. It does not matter whether the model is 'right' or not, as long as it reproduces prices in conjunction with the calibration that we happen to be using. When people use the Black-Scholes model, it is because it is convenient and has roughly the right shape, not because anyone believes that it is exactly right. Also, where possible, we should always use implied parameters, not historic ones. The implied parameters are just those that, in conjunction with the model used, get back to market prices. Using anything else is not market consistent. When market participants quote an implied volatility, it is just a shorthand for the price. They are, famously: 'the wrong numbers, in the wrong formulae, giving the right

price'. The fact that market volatilities are typically higher than historic volatilities just indicates that the Black-Scholes model is just an approximation, albeit a successful one. The only real test of a calibration is, therefore, how well it reproduces market prices.

I take issue with the point which the authors make that this makes it possible to have two market consistent models that give different answers. I argue that, in such a case, at least one of the models is incorrect or, more likely, it is not calibrated. Getting an appropriate calibration dataset is where the art of modelling takes over and the science tends to fall behind. I look forward to the day when we see some research into how to hedge long-term liabilities using the shorter-dated, more liquid, options available, to remove some of the subjectivity around our ill equipped markets.

This brings me to the issue of credit risk, on which the paper spends some time. The real issue should not generally be: "What is the risk free rate?" Instead we need to ask: "What credit risk is there in the potential hedging securities to which we calibrate?" If the assets themselves are credit risk free, and our calibration reproduces these asset prices, the parameters which we put in the models are irrelevant.

When it comes to modelling assets underlying the asset share, the question of a risk free rate does not matter. Any credit risk is just part of the return on these assets, which are, in any event, just valued at face value.

When it comes to valuing guarantees, the appropriate hedging instruments are derivative securities, e.g. put options, swaps and swaptions. It is widely accepted, nowadays, that these are generally credit risk free. Derivative exchanges exist to protect against counterparty risk. There will always be some small, residual risk, but only of the order of a few basis points.

The implication of this is that no adjustment should be made to market prices of such derivatives when using them to calculate market consistent values, or calibrate market consistent models. In this context, I disagree with the authors' suggested approach to adjusting the prices of traded options to remove credit risk.

The only area where there is a real issue is in the valuation of fixed liabilities, including guaranteed annuity rate (GAR) liabilities. The problem here is that there are a number of instruments that are either risk free, or close to risk free, that could be used as hedging instruments, but where the spread of returns can vary significantly from one to another. What should we do? One approach is to try to derive a 'true' risk free rate from the various instruments available, and explain the difference between this and the actual returns on the different traded instruments in terms of credit risk, tax treatment, liquidity, supply and demand, and so on.

Mr K. Foroughi, F.I.A.: There are two areas in the paper on which I wish to comment: market consistent shareholder valuations; and lack of convergence for reported valuations.

Market consistent shareholder valuation is discussed in Section 7. The authors look to a day when the accounting basis is genuinely market consistent on both the asset and liability sides, where there would be no need to separately value the run off of in-force prudential margins. However, we appear to be a long way off achieving a consensus over a market consistent accounting basis. The recent November 2003 International Accounting Standards Board (IASB) board minutes indicated that, for Phase II of international financial reporting standards (IFRS) for insurance contracts, they would revisit their tentative conclusions from first principles, with no decisions reached until June 2005 at the earliest. This is just as well, because some of their tentative conclusions, such as the use of entry value as a fair value benchmark and the inclusion of market value margins, do not accord with the type of prospective valuations put forward by the authors. Also, it is unlikely that, by mid-2005, any proposed accounting basis will still not be truly market consistent.

For practical reasons, shareholder valuations will continue to start with a prudential balance sheet, whether for regulatory or primary accounting purposes, and examine the run off of prudential margins. I believe that analysts will continue to demand the publication of last year's value of new business, to enable them to proxy a value of future new business. Any other calculation may be too subjective for their liking.

We are then back to having both a value of in force and a value of new business calculation, it is hoped, determined using market consistent principles. Such methodology is already reasonably well developed, and has been implemented by several U.K. insurers.

In ¶2.4.7 the authors complain about the lack of convergence for reported valuations for life business, as compared with the banking world.

In these early days, I would argue that any lack of consensus around the exact market consistent method or value is not as material as the divergence that used to exist before market consistent valuation was widespread. Until recently, valuation actuaries were faced with the choice of subjective deterministic methods, including stress tests, or quantile reserving stochastic methods based on subjective statistical asset models, to try to estimate the cost of embedded options and guarantees. None of these valuation methods gave objective or convergent results. In this context, convergence in results of different valuations of the same business is one of the triumphs of the market consistent method.

For example, the Risk and Capital Assessment Working Party, in 2003, compared the total capital requirements of a simple unitised with-profits (UWP) bond, using four different quantile reserving stochastic asset models calibrated to 31 December 2002 conditions. They found that, for the same chosen percentile, the largest capital requirement result was consistently around two to three times greater than the smallest, and that that is before allowing for any differences in the choice of percentile by the valuation actuary.

In contrast, the With-Profits Working Party compared results using six so-called 'market consistent' stochastic asset models, also calibrated to 31 December 2002 conditions. Here, the largest differences in results were between 5% and 25% for a simple equity put option plus underlying, and between 3% and 9% for a GAR option plus underlying. I suspect that, if this exercise were to be repeated today, variations of the results of most models would be of the order of 5% or less — a historic low for the valuation of business with embedded options and guarantees.

In addition, I would naturally expect less convergence in the valuation of insurance products than the standard banking products. The insurance market is less efficient. If you were to look at some of the longer-term exotic options and structured products being offered by banks, you would also find such levels of divergence in the price. Convergence is desirable. 5% of a liability is a large number, and may mean the difference between being solvent and insolvent, so I appreciate the need to try and narrow this down. However, we should not underestimate where we have got to already.

References

IASB (2003). Minutes of the Board Meeting on International Financial Reporting Standards, 18-19 November 2003.

Creedon, S. *et al.* (2003). Risk and capital assessment and supervision of financial firms. Interim working party report, presented to the Finance and Investment Conference on 23 June 2003, and to the Life Convention, 11 November 2003.

Hare, D.J.P. *et al.* (2003). The realistic reporting of with-profits business. *British Actuarial Journal*, **10**, 223-293.

Mr I. J. Kenna, A.I.A.: I welcome the general acceptance, referred to in Section 2.2, that share prices are affected by the supply and demand for shares. This was not always accepted, and merits further consideration.

For at least 30 years, much more cash has been coming annually into the long-term financial institutions in the form of premiums, contributions, dividends, and so on, than has been paid out annually in the form of sums assured, pensions, and so on. In practice, outgoings have been paid out of incomings without the need to test the market by selling shares. This has saved dealing costs. It has also meant that terminal bonuses and other forms of capital appreciation are purely theoretical amounts. The new policyholder's premium pays for the old policyholder's terminal bonus.

There is also the problem of how to invest the excess of incoming over outgoing money. During the period there has been a continuous demand for shares. With only three serious blips, share prices went up and up until 31 December 1999, when the FTSE 100 reached 6,990.2, and shares were overpriced in comparison with low and stagnant distributable profits.

This situation of 'too much money chasing too few shares' explains why, as in Section 7.1, market capitalisation exceeds accounting net assets for all healthy quoted firms, whether financial or otherwise. When one considers the near exponential explosion of share prices which took place up until 31 December 1999, this excess is today still substantial, though not as large as at 31 December 1999. This excess is not worth anything until it is realised by the actual selling of shares. Anyone not selling shares is placing a bet against the future.

Mr M. R. Kipling, F.I.A.: I am Chairman of the Life Board Supervision Committee. The Committee is at present engaged in a thorough revision of professional guidance to coincide with the introduction of the FSA's Integrated Prudential Sourcebook, towards the end of 2004.

As announced at the Birmingham Life Convention in November 2003, there will be two types of guidance. The first will be guidance addressed to actuaries appointed to particular roles in the new regime; actuarial function holder, with-profits actuary, and so on. It will mainly cover the obligations of the particular roles. The second type will be technical guidance, which will set minimum standards for particular tasks, irrespective of the actuary (or other person) carrying them out.

We are, at present, preparing four technical guidance notes covering mathematical reserves, with-profits insurance capital components, individual capital assessment, and the use of stochastic models. The note on stochastic models will be relevant to all the other three, particularly to those on the with-profits insurance capital component and on individual capital assessments.

Guidance will be applicable directly to actuaries carrying out these activities under specific FSA rule requirements. However, they will also count as 'generally accepted actuarial practice', and so be required to be taken into account by firms, where the FSA rules place obligations on firms rather than directly on specified actuaries.

We intend to expose, informally, our work in progress at the Current Issues seminar in April 2004, and for the notes to be finalised and put through as much due process as possible as soon as the FSA makes final rules. In the meantime, we hope that members will begin to take into account the direction being taken, as observed from the April informal exposures.

Of particular relevance from the paper is the guidance on stochastic modelling. This is being developed by a working/consultative group, which includes members from the FSA, from regulated firms, from potential reviewing actuaries, and from more than one economic model provider. It is taking forward the work of Mr Carl Dowthwaite's 2003 working party on stochastic modelling, which reported at the November Faculty sessional meeting (*British Actuarial Journal*, **10**, 151–163) and also at Birmingham. Both Mr Dowthwaite and one of the authors, Mr Andrew Smith, are members.

Amongst the issues which we are currently investigating are:

— explanations of the spread between the gilt yield curve and swaps and other government-backed sterling fixed-interest securities;
— the stochastic modelling of annuitant mortality improvement;
— stochastic property models, discussed by Booth & Marcato (2004), and the implied high cost of property option trading (which mitigate against such a market coming into being);
— the possibility of setting a minimum standard relating to 'fat-tail' calibration of U.K. equities; and
— extrapolation of parameters, especially volatility, to durations where markets are illiquid.

The guidance will embrace both models for 'market consistent' valuations and 'real world' models for ICAs, and will highlight the differences.

We will be taking into account all comments made in this discussion, and look forward to an interesting ongoing debate at CILA and over the summer.

REFERENCE

BOOTH, P.M. & MARCATO, G. (2004). The measurement and modelling of commercial real estate performance. *British Actuarial Journal*, **10**, 5-73.

Mr S. C. Mills, F.I.A.: There are two areas on which I wish to comment. The first is the gilts versus swaps debate. My position is diametrically opposed to the authors, as I believe in the use of a yield curve that reproduces LIBOR and swap rates. This is the yield curve that underpins all of the derivative markets, and it is unique (unlike gilt yield curves, the level of which depends on which gilts are used to derive the curve). To attempt to value guarantees using gilt yields, rather than LIBOR, feels like trying to fit a square peg into a round hole.

If you are a derivatives trader pricing an option, you will have a Black-Scholes formula into which you can plug an interest rate and a volatility taken from your current market volatility matrix.

If actuaries are going to use a different interest rate in the formula, then we can either replicate the market volatilities or the market option prices, but there is no way in which we can replicate both. I wonder whether any thought has been put into which one of these two is more important to replicate, if we are going to go with gilts.

Recent FSA correspondence talks about the possibility of using interest rates derived from swaps, but, maybe, with a reduction for credit risk. The problem may be that we are not clear with which market we are trying to be consistent. If we are trying to be consistent with the market for derivatives, there is no need to put that credit adjustment in.

My second point is one which is of increasing concern to auditors looking at realistic balance sheets. That is whether market consistent valuation really is objective. The authors, in Section 2.4, point out that this is one of the big motivations for market consistent valuations, and I agree. It would be a mistake to think that they are totally objective. The derivative market is not complete enough to give us all of the parameters that we need within our models to be market consistent, for example: equity volatility at long durations; property volatility; and correlations between returns on different asset classes. If there are not derivatives out there in the market, whose prices depend on these things, there is no way you can find parameters out in the market. The question that the calibrator needs to ask himself is: "What would be the price of a derivative that did depend on this parameter if there was a derivative out there in the market?" The paper pointed out that that is difficult. If you think about property, your first thought might be to say that you could use a similar model to equities, but with a lower volatility. However, as the authors point out in ¶7.3.5, if property derivatives were available in the market, the difficulties in hedging them by buying and selling small tranches backwards and forwards means that volatilities would actually go through the roof. So, things are not that simple. Maybe there is a need for a central body to rule on these things, and give guidance on all of the subjective areas within a market consistent valuation. That is the only way in which you are going to be able to get values that analysts could look at and know were consistent between life offices.

Mr I. R. Moran, F.I.A.: I wish to focus my comments primarily on actuarial standards.

In ¶2.5.2 the paper discusses the commercial implications, where there is leeway, on liability valuations; in particular the consequence of identifying best practices, when, maybe, lesser practices may lead to lower valuations. In my experience, this is a real rather than a theoretical issue, but it is to the credit of the profession that it is less prevalent than it might otherwise be, and it also highlights the conflict between the commercial and the professional roles and the need for any standards to be demonstrably independent.

Paragraphs 4.3.5 and 4.3.7 inform us about issues over data. The authors use the example of equity volatility, where they suggest that long-term data are merely extrapolated from short-term data. If the investment bankers, whom you have contacted to get your price, know that you are not going to buy or to sell at that price, they will do whatever is easiest. They will take a shortcut, and simply extrapolate. This highlights the need for professional scepticism in selecting

and relying on market data, and professional judgement in estimating key assumptions in the absence of reliable data, and appropriate training or access for the actuary to have experts in this area. Guidance on the sampling and use of market data would be useful.

Section 2 discusses the appropriateness of market consistency as a measurement objective. While I accept the merits of arguments for market consistent value for reporting, the profession should encourage further debate.

The production of guidance for individual actuaries has not kept pace with the rapid development of realistic balance sheets. We are exposed to the regulator changing the requirements and backfilling the gaps in technical developments. The paper provides excellent and robust information about many of these technical aspects.

Mr P. D. Needleman. F.I.A.: I shall comment on three areas. The first is the complexity of calculations and dynamic interactions. The move to realistic reporting and, in particular, recognising the true value of the options and guarantees inherent in with-profits contracts is an enormous and important step forward for the industry and the regulators. Companies now need time to bed down their systems and their controls. Whether they are using closed form solutions or Monte Carlo simulations, they need to ensure the robustness of what they have developed.

One of the issues upon which the paper focuses is the use of closed form solutions to value many of the options and guarantees embedded in with-profits contracts. The paper advocates the merits of this approach rather than the use of Monte Carlo simulations. It demonstrates how formulae can be developed to allow, to some extent, for dynamic management actions and other complexities. The authors, themselves, recognise the limitations of closed form solutions and analytic formulae. In particular, they note, in ¶8.2.2, that they cannot be used when the investment mix depends on the free asset ratio. In practice, that is the situation which applies to most companies.

I believe in the 80:20 rule. You get 80% of the benefit from 20% of the effort. The same applies here, and I would caution against trying to achieve a level of theoretical correctness which ignores the practical realities.

My second point is about asset strategy and hedging. One of the main risks in with-profits funds is the mis-match risk arising from having a heavily equity backed investment strategy whilst providing onerous guarantees. As companies become more capital constrained, they are having to become much more sophisticated in their approach to hedging these guarantees. Section 9 quite rightly points out that this will mean moving away from crediting uniform investment returns to all policies. Some companies are already following different investment strategies for assets backing guarantees' reserves, and, in a few cases, are differentiating the equity mix for major groups of contracts. In some cases this is based on business written before or after a specific date (for example, the date of demutualisation), and in other cases for different classes of policies. I am aware of at least one company which is considering a more sophisticated approach to differentiating asset mix by duration and/or the extent to which guarantees are in the money. A key concern here is whether a differentiated policy is consistent with treating policyholders fairly. The FSA has expressed some concerns. The answers will depend on the precise circumstances and approach, but we will see, and should allow a much greater degree of differentiation in the future.

I now consider the need for guidance and greater consistency of approach. The industry and the profession are moving forward rapidly with the implementation of market consistent valuations. As with other areas of actuarial and financial theory, there is significant scope for judgement and differences in opinions. The paper highlights some of the more contentious areas, but, unfortunately, it is diminished by the authors' apparent assumption that anyone holding differing views to their own must have questionable motives. Such an innuendo is quite unhelpful if we are to stimulate appropriate professional debate.

The profession has established a working party to provide guidance around stochastic models, and I am sure that those serving on it will frame guidance with appropriate professional impartiality. I hope that this can be framed in a way which provides a level playing field, but

still allows scope for judgement. On the question of level playing fields, let us also make sure that the U.K. reserving and capital requirements are not so far ahead of our other European insurance markets that we have no industry left to regulate.

Mr D. A. Smith, F.I.A.: My comments relate to the more practical aspects of stochastic modelling, and are in respect of an office that has had a stochastic model on part of its with-profits business for almost 15 years. In recent years a new stochastic model has been built, using a modern platform. This now covers 95% of with-profits business. Using 25 PCs linked together, a stochastic run of 1,000 scenarios runs overnight. With 75 dedicated PCs, three runs can be achieved each night. With that hardware, some simplifications have been necessary. A slimmed-down model point set, with just 10,000 cells representing the in-force business, means that some of the accuracy of more detailed deterministic models has been discarded. Also, the controlled projection and review of bonus rates up to 20 years ahead has been replaced by codified rules applied automatically, even in extreme situations. In the context of a fair value of liabilities (as originally proposed by the IASB), this approach may be acceptable, as mean values will depend on the middle scenarios more than on the tails. However, while this realistic fair value is a relevant measure, unless the liabilities are hedged, then it is only part of a picture. A fuller picture comes from a risk-based capital assessment; but, in this case, and also in the FSA's realistic solvency valuation stress tests, it is the extreme conditions which will determine the capital required. As such, a formulaic bonus approach could produce very different results to those that would follow detailed consideration, if such conditions actually occurred.

At a more fundamental level, there is a question whether the aim of a market consistent valuation is a sufficient principle on its own. Investment markets value financial instruments of uncertain value, such as equities, efficiently, in that a relatively deep and liquid market exists. However, the derived values undergo significant realignments from time to time, in a manner that would not be desirable in the context of the prudential supervision of insurance companies. This might be taken to indicate that there should be a further principle of financial soundness, so that the implied assumptions, including future returns and volatilities, represent a reasonable, sound and stable set of assumptions for the future.

Summing all this up, while having a realistic valuation of life assurance liabilities as the basis of published financial accounts is a commendable aim, the subject is only newly developed, and will need to evolve. In the meantime, liability values and capital requirements placed on our businesses can be expected to fluctuate, due to modelling issues and due to methods applied for exercise of management discretion, as well as due to market conditions. This leads to a view that reporting of realistic balance sheets should, at this stage, remain confidential.

Mr E. R. Stumpf, F.I.A.: Section 8 discusses the relative merits of Monte Carlo modelling versus closed form alternatives. Specifically, I should like to make the case for closed form solutions, not as an alternative to Monte Carlo methods, but as a complement to such methods.

The paper provides extensive applications for closed form solutions in the calculation of market consistent values for insurance liabilities. These methods are potentially ideal for the calculation of a realistic balance sheet in many scenarios. However, they do not imply that closed form solutions should be viewed purely as an alternative to stochastic methods.

Stochastic modelling is a very powerful tool for managing an insurance concern. It is easy to understand, and it enables managers to study distributions of values, and not just single numbers. The combination of closed form solutions, such as those provided in this paper, with Monte Carlo modelling provides an even better tool for analysing an insurance fund. I have seen this in practice for the projection of a company's realistic balance sheet under stochastic conditions. A stochastic Monte Carlo model was used to generate future scenarios and revenue accounts, and, for each future year of each scenario, a closed form solution was used to estimate the realistic balance sheet liabilities. A graphical presentation was then used for the results, and the company was able to see the spread of free asset ratios at different percentiles for each year

of the projection. For the company to see this stochastic development of the company's future was amazing. I am now convinced that the use of both Monte Carlo and closed form solutions together has valuable implications for understanding solvency in the future, and for the calculation of capital requirements such as ICA.

Mr N. H. Taverner, F.I.A.: I am actively involved in the corporate valuation of life insurers in an M&A context. The theoretical aspects of valuing insurance cash flows, covered in the paper, can be developed into closed form solutions for valuing individual contracts or homogeneous portfolios, provided that there are relatively few non-economic assumptions which have correlation with the markets. This may not be the case in practice, particularly if we are looking at a corporate valuation, where, for example, market correlated policyholder behaviour, such as lapse, surrender and propensity to buy, could clearly affect the value via future unit costs, for example.

I was disappointed that the authors did not devote much time to valuing insurance businesses as a whole. In Section 7 they set out a summary of the valuation framework of net assets plus franchise value less frictional costs, without further developing the theory, as set out, for example, in the paper referred to in ¶7.2.5, towards a practical approach for corporate valuation. This may, perhaps, be due to the difficulties of using closed form solutions for such a purpose, problems which may also underlie some current attempts to estimate market consistent valuations by simplifying frictional capital costs down to just taxation and a subjective assumption for agency costs, and by assuming that key non-economic parameters are entirely non-systematic, and can be treated deterministically.

The frictional costs of supporting capital at a sufficient level to support franchise value and/or for regulatory or internal purposes, will be higher for a company which is exposed to higher volatility in its results, whether this volatility is market correlated or not. Companies with potentially volatile results should be holding more capital in the first place, and so valuations which do not look at capital requirements, and how they evolve in future, may potentially understate, or overstate, the frictional costs. Companies which can demonstrate a clear understanding of required capital, capital strategy and capital costs, may be able to argue that any residual agency costs assumed should be lower than if they cannot. It may be possible to derive better approximate methods for allowing for frictional costs, and these may be used as a short-term solution. However, it seems preferable to me, in the medium term, to be working towards efficient stochastic simulation models for capital adequacy that can also be used for market consistent corporate valuations. As suggested by the authors, it could well be that closed form solutions, for at least some elements of projected balance sheets, will be an essential part of such models.

Considerable thought and specialist expertise is necessary to construct closed form solutions in both the approximations necessary in order to be able to apply them and in the formulae themselves. The authors mention that different actuaries are likely to derive different solutions and values, depending on their views of policyholder behaviour, and so on. I have some concerns as to the length of time that it would take for a potential buyer of a company, in an M&A context, to satisfy itself of the appropriateness of a closed form model, and, if necessary, to adapt it to reflect any different views that it might have of policyholder and management behaviour, particularly as the impact of the results as part of a larger group could be quite different from that on a stand alone basis. Stochastic simulation techniques, while, perhaps, more time consuming to run, seem to me to be far more amenable to independent verification and, perhaps more importantly, to understanding.

Professor A. D. Wilkie, C.B.E., F.F.A., F.I.A.: This is a very useful paper, but it is only part of the story. You need a simulation model which represents the real world and is as complicated as you like, and inside that you simulate the hedging strategy that you are going to use. An important point that earlier speakers have commented on is that the value of an option depends entirely on the fact that you can hedge using the right sort of assets, so that option pricing

depends entirely on the assets available to hedge. Consequently, you cannot say that the value of the liability is independent of the assets. You need to know, therefore, the hedging proportions, which are not readily available from the paper.

The advantage of the real world simulation is that you can put in all sorts of complications. For example, you can allow for management activity, parameter uncertainty, and uncertainty about mortality. You end up with prudent values as well as average values. The fair market value is then the average plus some allowance for contingency reserves. The authors recognise this when they write, in ¶6.4.3, about the difference between implied volatility and historical volatility. The actual option prices are bigger than what one might call the theoretical net option prices, because of all these other factors that they have mentioned, in particular the necessity for the option writers to have additional reserves because they cannot hedge perfectly.

If you are then going to embed the hedging strategy within the real world simulation model, you have to use closed form solutions. I would prefer simple closed form solutions in a complicated real world stochastic model, than such an elaborate option pricing model that you can only calculate with simulations inside other simulations. This is why it is only part of the story; but it does sound, from what Mr Kipling was saying, that the Life Board is taking on part of what I was saying already.

Mr R. I. Sykes, F.I.A.: There were some references to the BT Fund pension deficit in the paper. As a pensions actuary, it is good to be in a meeting where actuaries discuss what should be the correct discount rate, and argue about the difference between gilts and swaps.

It worries me that there appears to be a difference between the two arms of the profession. For instance, why should there be such a difference between the value placed on pension liabilities if they are held by BT, and if they are taken over by an insurance company? It just does not seem to make sense.

Many pensions actuaries have happily accepted FRS 17 as being a move towards realistic valuing, but we must remember that, although it is a move in the right direction, the fact is that it is still valuing the liabilities using the wrong discount rates. We should not give up the fight to get correct and transparent accounting.

On a separate note, all of the models cited in the paper rely on information about market prices, particularly of options. As an actuary working in a pensions department, I would like to have access to that information. The Institute might consider making some of this information available.

Mr G. S. Finkelstein, F.I.A.: The author's definition of market consistency in Section 1.1 seems a bit limiting, as it requires replicating market prices only for the calibration assets, which can make it too easy for a model to be market consistent. Market consistent liability valuation models need to be able to place the same value on liability cash flows as the market value of assets with the same cash flows, regardless of whether or not the assets were in the calibration set.

With this stricter definition of market consistency, it becomes easier to justify calibrating to swap curves. If the replicating asset is an interest rate derivative, such as a swaption, and market traders have calibrated their derivative pricing models to swap rates, then it seems legitimate to calibrate our liability valuation models in the same way. In any case, we have got bigger things to worry about than the relative merits of swap rates and gilt rates.

Sections 4.2 to 4.4 provide a lengthy discussion of the practical problems encountered when trying to calibrate models. The problems are mainly caused by the scarcity of market data against which to calibrate. These problems are generally well known. I was disappointed that the authors did not offer many solutions, or ways to deal with these problems.

In ¶4.3.4 the authors suggest that options over five years are not available (even over the counter) from banks. I am aware of some banks which are willing to trade for terms of ten years, or even longer.

Also, arguments that the market is not liquid should not obstruct progress in seeking market

consistent prices. Nearly seven years ago I was involved in one of the first large guaranteed annuity option (GAO) swaption hedges. Back then, industry sentiment was that the liabilities were deferred for too long, and then the annuity terms were too long, and such long-term hedges were not available. However, a bank did synthesise such a long-term swaption, and then another bank did it for another company, and, before long, there were many banks knocking on the doors of insurance companies. My point from this is that markets are created by market makers, and market makers create the market if the demand for the product exists. So, when companies find that they may need to hedge other long-term guarantee liabilities, the demand will increase, as will the supply of market quotations.

Although I agree with Mr Sykes on the need for some kind of database of volatilities or other market consistent parameters, I cannot see this being practicable in the forseeable future. Hence, we will need to make do with friendly banks and the databases maintained by commercial organisations such as Bloomberg's.

I found the tax analysis in Section 3.5, for determining the adjustments to risk free rates for life funds, spuriously accurate. This is clear in the numerical example in ¶3.5.6, which is quite an extreme example in terms of gradient on the yield curve. Fortunately, the analysis in Section 4.7, was much more helpful. However, there are a few other points to note:

— The valuation method places a capital value on a large number of guarantee cost scenario outcomes. Stochastic simulation models use large sample averages. Closed form formulae use population expectations. Many of the scenarios under which guarantee costs bite involve negative investment returns and capital losses, which, in life funds, can generally only be offset against future capital gains. Therefore, it is not clear what rate to net asset share growth rates, as this will be scenario dependent. Some scenarios can be so harsh that the tax position of the life fund as a whole could change (from XSI to XSE), in which case notional profits' assessments start applying, and the fund can start to earn gross risk free.
— Pensions business is taxed on a profits basis. Usually a so-called 'needs test' applies, in which case the fund may be able to earn the risk free rate gross of tax. Under some scenarios the 'floor test' may apply, in which case a tax allowance may be required.
— An alternative method involves valuing the liability by considering the market value cost of hedging or transferring the risk to a third party. If the hedge counter party is taxed on a profits basis, then the pricing may well assume a gross risk free rate; however, then, you would need to consider what tax you would suffer on hedge payoffs (and specialist tax advice may be needed).

The compound option, suggested in ¶5.7.8, is interesting. Can the authors include a derivation of the formula? For the benefit of those who wish to see how formulae for compound options are derived, Geske's original work on compound options was in 1977, and this was extended in papers by Hodges & Selby (1987) and Rubinstein (1991). These papers should also help give insight for the synthesis of the delta hedge for such options; the deltas being obtained by differentiating the value of the compound option with respect to the underlyings.

The authors did not include a derivation of their formulae for the deflator for the Hull & White model (¶4.5.4). Those who attempt to use the formula blindly, in models with more sources of randomness, such as bivariate equity models and/or exchange rate models, the overall market of assets may no longer be 'complete' and the deflator may no longer be unique.

On the question of the relative merits of stochastic models versus closed form formulae, I agree with the comments made by Mr Stumpf, that the two techniques are very powerful together. Being able to project future market values (using closed form formulae) under many scenarios (embedded within a stochastic model) is very powerful for projecting future realistic balance sheets and testing management strategies based on realistic balance sheet positions.

I take issue with the authors' comments in ¶2.4.7.4: "Insurers spend correspondingly greater effort in the search for favourable tweaks" (compared with banks). Comments like that are not helpful, and I question how much experience the authors have in assisting banks with the preparation, or auditing, of their accounts, in order to be able to make that statement.

References

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Rubinstein (1991). Double trouble. *Risk Magazine*, **5**(1).

Mr M. N. Urmston, F.I.A.: I support market consistency, but we need to understand the position of the industry as a whole, and the position of, not only with-profits funds, but also life insurance companies in the U.K. They do not have an unlimited amount of capital at the current time. What we have seen over the last few weeks is not necessarily to the advantage of the industry. We have seen a major life insurer having to sell very large amounts of U.K. equities, driven by their results. Although a big supporter of market consistency, we should try to manage the transition carefully, and hope that the FSA will try to do that, not just for with-profits funds, but for shareholder funds and for non-profit funds, as we move further down this market consistent road. We have not discussed the pricing of annuities, but there are very few companies out there pricing annuities on anything like swap rates or risk free rates.

The issue with Monte Carlo methods is the difficulty of doing all the calculations. If you do them, you usually discover that some of the tail scenarios are quite remote and very extreme, and maybe ones that you can deal with by sensible management actions which are not in your normal management actions set. That is an argument for the use of Monte Carlo methods.

Mr Dullaway: We are trying to achieve two completely different objectives with a market consistent valuation. If we are trying to set a solvency valuation, we are using market consistency as a tool to ask, if things go badly wrong: "Do we have enough money to go and buy some hedging assets and basically get out of the game?" If that is our purpose, it tells us a lot of things about calibration, about tax, and so on. It tells us to calibrate to what is out there; it tells us that, if you cannot buy it, it is not worth thinking about. It tells us that the tax position that we are interested in is the one that we are going to be in when things go wrong, and we will have to go out there and do the hedge.

If, on the other hand, we are talking about market consistent valuation as a measure of shareholder value, then we are asking quite a different thing. We are asking: "How does the market generally look at these cash flows, given that you keep them within the company?" Much more important is what the real risk free rate is, because we are asking how people think about cash flows as a whole, not within a particular hedging circumstance. We need to take account of individual credit risk, and the tax that would apply is the tax when you carry on running as a going concern.

We have many problems — disagreements between risk free rates, tax approaches, and so on — simply because we are not clear, and, to be fair, the FSA is not always clear, about what it is that we are doing when we try to achieve market consistency. If we can agree on that, we will find that the differences between people with different views are far smaller, and the range of results which we get is far narrower, than we are seeing at the moment.

Mr P. J. Tuley, F.I.A.: The issue of the correct rate of return to calibrate to is difficult. However, it would be a sad mistake to rely on banks as risk free, by using the swaps curve, in a similar way to our previous reliance on reassurers, without much appreciation of the credit niche that is inherent in any debt.

We have reached near to a clear view of the real niche in a with-profits fund. What we have also achieved is a clear view of the internal trackers and support between the policies within a fund.

The least important element of clarity is the ability both to hedge risks that are too large for the strength of a fund and to see the benefit of such actions on the face of the balance sheet.

That, of itself, must help good management of funds. Good management of funds is, I hope, going to be a lasting result of these new methods, and we actuaries should grasp that.

Mr S. Creedon, F.I.A. (closing the discussion)**:** This paper, and the discussion, are important, not only in the context of the FSA's aspiration to implement a modern regime of balance sheet supervision here in the U.K., but also in the context of similar moves at the European level, which will shortly move into high gear.

The importance of this subject is not confined to life assurance. Although less significant, there are some direct parallels in relation to general insurance, and I can, with Mr Sykes, envisage a growing interest in a market consistent assessment of the position of pension schemes.

I agree with the authors, and with those who contributed to the discussion, that perfect market consistency is an unattainable aspiration. I also agree that the realistic objective is to eliminate, so far as we can, the market inconsistencies which have survived in some dark corners. Certainly, the techniques proposed by the authors should inform the future pricing of liability origination and the management of existing liability portfolios.

It is unfair to the authors to share the wish of Professor Wilkie that they had written a different and broader paper. I find it hard to separate the aspiration for market consistency from the broader objective of assessment of the adequacy of total assets to meet liabilities in adverse circumstances. In fairness to the authors, I worked alongside both of them last year and this in investigating some of the issues in capital and asset adequacy assessment, so perhaps they may come back again!

An advantage of considering valuation, in the context of asset adequacy assessment, is that different judgements made in valuation should, all other things being equal, be balanced by opposite differences in the margins required to meet a given level of stress. Provided that the supervisor is aware of its actions, an element of arbitrariness, or simplicity, in determining valuation principles is not the end of the world.

The FSA and the U.K. Actuarial Profession have moved slightly out of step with counterparts in other jurisdictions in the current heavy emphasis on realistic liability valuation, when it is really asset adequacy which should be the primary concern of us all. I suspect that this is just a temporary difference of emphasis, reflecting some of the unique characteristics of U.K. with-profits business. In a recent presentation with Dutch colleagues to supervisors in Bonn of the contrasting U.K. and Dutch approaches, simultaneously we all reached the conclusion that combining the U.K. and the Dutch approaches could actually create something sensible.

I now turn to some of the themes of our discussion.

The points made by the authors in Section 2, and echoed by others, on the possible motivations for market consistent valuation, are valuable, if only to push the FSA to think harder about its own motivation and requirements. In practice, the objectives of understanding share price and closing out risks are somewhat aspirational, and, realistically, the best to be hoped for is a set of principles and processes which assure auditable objectivity on a basis which is not market inconsistent.

A couple of speakers valuably exposed the pitfalls in market consistent valuation in the M&A context, and the need for careful exercise of judgement in this area.

Supervisory policy was discussed in Section 2.5. The authors had considerable fears. I do part company with the authors here, in that I am less pessimistic about either our profession or our supervisors. I believe that the supervisory approach in CP195 is ingeniously designed, and creates an incentive for firms to achieve a reduction in individual capital guidance (ICG) by building a track record of credible individual capital assessment (ICA) — this is exactly as it should be. The supervisor rightly seeks an adult relationship with the supervised.

Model control was a topic that was touched on by a couple of speakers. The modelling of liabilities potentially needs to be granular in a different way from traditions. Our United States and Canadian colleagues have already established that issues of model design and model validation are not at all trivial. Mr Smith touched on some of the physical aspects of building a useful model.

A good auditor will be keen to understand any differences between the approach to liability valuation and the way in which management approaches pricing and other management decisions, and making that link will limit the subjectivity which the authors feared.

The distinction between efficient and liquid markets and other markets was a theme throughout the discussion, one which the authors acknowledged, and for which they gained almost universal support. There are no easy answers here. A point worth making is that the market for insurance business has the potential to become more efficient. There are signs that customers, although behaving irrationally, are acquiring increasing rationality in their behaviours. The subject of management and customer behaviour generally was not greatly discussed. Some took the view that it was more significant than the authors have allowed, and that allowing properly for management and customer behaviour needs to be able to use Monte Carlo simulation approaches. The authors' approach to the difficulties of taxation was supported by Mr Finkelstein.

I sense widespread support for the view that both formula and Monte Carlo approaches have their place, and deserve to be used in parallel. Closed form solutions can offer greater understanding in certain contexts. Simulation is the sledgehammer which can address dynamic behavioural dimensions.

Standards and guidance were a theme of the discussion. I echo those who said that this is an issue of which the Profession is very aware and understands the need for standards which command wide support, not only among actuaries, but with the public. It is not a simple challenge, and the leadership of the profession is well aware of organisational issues and issues about what standards should look like in terms of the balance between principles and rules going forward.

The gilts versus swaps issue is significant. History shows that swap spreads have, at times, particularly outside the U.K., been very material, and there is a great deal of (unfortunately inconclusive) academic research on the reasons for swap spreads. In the discussion, I scored about 50-50 for each approach. I can only go back to the point that I am not sure that there is a right answer here, but, in any event, it should be offset by the degree to which assumptions are stress tested.

Mr A. D. Smith (replying)**:** Most of the contributors have reinforced our conviction that market consistent valuations are a commercially useful tool rather than just a dry compliance exercise. Mr Creedon has said that a perfect market consistent valuation is an unrealistic aspiration. The opener also said that it is a major exercise to compute an answer to an auditable standard within agreed budget and timescale, avoiding results which upset shareholders, policyholders or analysts.

Several speakers raised questions about hedging and hedging errors. Professor Wilkie spoke about the need to calculate hedge errors under a real world model. We agree with that. For pricing purposes, you would want to figure out how much capital you need and what the cost of that capital is. Just as importantly, if you are calibrating your asset model to market option prices, you would want to recognise that some of the market implied volatility corresponds to somebody else's cost of capital. To avoid double counting, you would need to strip that bit of somebody else's cost of capital out before you calibrated your model and added in your own cost of capital. It is not easy to do. More work on the details is needed. It would be unfortunate if professional standards drawn up now unwittingly exclude that kind of model from being used in future for market consistent valuation.

Several speakers have talked about the use of the right discount rates. One way of viewing this is to suppose that one of you holds a corporate bond and tries to replicate that corporate bond by holding a deposit which earns LIBOR with a bank, and then I hold a swap to turn that LIBOR into a fixed rate at the same terms as your corporate bonds. We actually have a lot in common. We are both earning more than the rate on gilts. We might actually be earning the same rate. We are both subject to credit risk. At the moment, under CP 195, you would have to do a stress test for a credit risk and I would not, which most people would probably agree was an anomaly.

I was reassured to hear that nobody is claiming that swap rates represent a rate that is free of default risk. Instead, the argument has moved on to whether some credit for default risk should be allowed in regulatory liability valuations. That is an indication of how far we have come, although it seems a little odd that one should look at the credit risk of some bank, that you might have no dealings with, implicit in the swap rate, rather than, for example, your own risk. It also seems odd that nobody is arguing for the same deduction for credit risk in relation to unit-linked policies. Why should it apply only to with-profits policies? Fortunately, the stochastic modelling guidance people are looking at that in more detail. In relation to the suggestion by Mr Mills that it was difficult to use gilt rates to calibrate a model and then replicate option prices, it is not actually that hard. We show how in ¶4.3.9. The trick is to realise that the option is subject to credit risk, and needs to be valued as such. If you pretend that a long-dated option is free of credit risk, then obviously you will not get back to a market price which does reflect the credit risk.

Mr Mills mentioned that the valuation of liabilities is an incomplete market problem. That is right. In the absence of imperfect hedges, there is no unique valuation. This explains how you could, potentially, have two models both claiming to be market consistent and giving different answers.

The opener spoke about implied correlations. I suspect that when he looks at market prices, the ones I have seen, your implied correlation, the bid-offer band, is between about minus one and plus one, so is not very useful as a way of calibrating models.

With these difficulties in calibrating models, in many cases the answer is much simpler than is required by a complex model. For example, it is very straightforward to value guaranteed minimum benefits using risk free rates. These can actually constitute a large part of a realistic balance sheet. The difficulty of valuing a five-year guarantee is not an argument for not dealing with fixed cash flows sensibly.

Furthermore, the lack of a unique valuation only applies if you restrict consideration to arguments based on exact hedges. There are all sorts of equilibrium arguments and partial equilibrium approaches. The opener suggested that one should look at market implied volatilities for short-term guarantees, and then try to blend into something more historically based for the longer term; but, in ¶6.4.3, we give a large number of reasons for the difference between historic and implied volatilities.

I am encouraged by the level of support for an Actuarial Standards Board, and for its role in providing consistency for financial reporting and market-based valuations. I fear, however, that some have imagined that this board has an administrative function, collating implied volatilities from a range of banks. We have argued that much more than this is required, especially in over-the-counter markets, where trades are infrequent and the terms are confidential. Whatever body sets long-term at-the-money U.K. equity volatility assumptions will need suitable terms of reference and enough independence to make sound and transparent judgements, which will inevitably carry significant commercial consequences.

A few speakers noted the limitations of closed form option pricing formulae, particularly when offices set bonus rates using dynamic fund level decisions, or when dynamic guarantee costs are charged to asset shares where credit risky assets or liquid assets are used. We acknowledge these points in ¶8.1.4. Let us not forget, however, that these complicated rules for bonus rates that we are trying to model were not, until recently, written down. Subsequent codification was often with the specific aim of building Monte Carlo models. We should not be surprised that it is easy to copy and paste those rules into Monte Carlo models rather than closed form solutions. If you have a second chance, which many offices now do as they rewrite their principles and practices of financial management (PPFM), why not make life easy for yourself with management practices which are relatively straightforward to model?

Mr Chaplin suggested that closed form solutions would necessarily give higher answers than Monte Carlo models. That is not our experience. In fact, we usually use Monte Carlo models to calibrate closed form solutions. As a matter of calibration, you would hope that they tied up pretty closely.

Finally, valuation models have developed apace over the last year, and there is little sign of this slowing down. We have made an attempt to organise the techniques currently available, and hope that our words will not be the last.

The President (Mr J. Goford, F.I.A.): We have been talking about market consistent valuation. This is going to be used to add a fairly arbitrarily determined internal capital assessment and internal capital guidance to get a determination of a cash flow like the dividend capacity or capital requirement. What puzzles me is: "Are all the refinements that we have been talking about in this paper going to be completely reversed, or swamped, when we add the internal capital assessment?" I then ask: "How can we actually do a realistic valuation without knowing what the dividend flow or capital requirement is going to be?"

Getting life and pensions actuaries together is close to my heart, so I wonder whether, for pensions schemes, we should also be calculating a risk-based capital figure, so that finance directors get some idea what allocation of reserves might be required to deliver the promises in the scheme booklet. That is something to think about.

It remains for me to express my thanks, and the thanks of all of us, to the authors, the opener, the closer and those who participated in the discussion.

WRITTEN CONTRIBUTIONS

Mr M. Iqbal, F.I.A.: For a couple of years I have been concerned at the view gaining momentum that market consistent stochastic modelling will sort out all of the life industry's problems. Dullaway & Needleman (2004) went some way to explain that there are practical difficulties. The authors have taken it much further, and highlight the substantial areas where judgement will still be required, and which, unless the range of choice is narrowed, could be a weapon for the mass destruction of reputations.

I have one comment of detail which relates to the concept of franchise value and frictional costs. The theory behind frictional cost is seductive; it is the amount of value lost because the imperfections of the real world, not least management, thwart the realisation of the full franchise value. The danger is that it ends up being a balancing item, and, if it does, it will provide no real guidance as to whether the franchise value is right in the first place. For these reasons, the value of the concept is in the analysis of the discrepancy; the reconciliation process can shed more light than the absolute numbers.

I have a general observation, which is to wonder whether the new techniques would enable the with-profits fund to be better run in the future than it was in the 1990s. I ask this, because it is not techniques, but management actions, that determine the success or failure of companies. The authors' firm ran two series of seminars, one in 1997/98 and another in 1999/2000, warning firms of the imminence of falls in bond yields and the need to look at their asset/liability position. No one quarrelled with the thesis, but very little heed was paid to it.

Would firms have reacted differently if the regulatory regime now being put in place was around then? On its own, I would doubt it, but, when coupled with the separation of the role of the with-profits actuary, it probably will. I say probably, because what we have seen over the past 30 years is that there is a business cycle of optimism and despair. In periods of optimism (1986 to 88, 1997 to 2000) management does irrationally optimistic things, and in periods of despair (1991 to 1994, 2001 to 2003) it goes the other way. It is for this reason that I was saddened to hear from Paul Sharma, at the discussion of Dullaway & Needleman (2004), the banking analogy of trying to look after individual firms getting out of step and dealing with collective problems, in the case of banks, by pumping in liquidity. Frankly, with insurance business I would rather it was the other way round — look after the flock, and let the odd sheep fall prey to the wolves if it is careless.

REFERENCE

DULLAWAY, D.W. & NEEDLEMAN, P.D. (2004). Realistic liabilities and risk capital margins for with-profits business. *British Actuarial Journal*, **10**, 185-316.

Mr D. I. W. Reynolds, F.I.A.: There was considerable discussion of the gilt interest curve, in connection with the choice of gilt rate or swaption, as a valuation basis. However, I recall that, in his sessional paper, Robert Clarkson (Clarkson, 1979) developed a gilt surface that took account of coupon rate as well as term. Subsequently, a number of other surface models were developed, and I recall that even the Bank of England changed its approach to issue pricing to allow for a three-dimensional model of interest rates.

Whilst science has moved on, are we in danger of forgetting some of the past developments? Can the techniques now being developed be extended, or amended, to allow for gilt surfaces?

REFERENCE

CLARKSON, R.S. (1979). A mathematical model for the gilt-edged market. *Journal of the Institute of Actuaries*, **106**, 85-148.