

A UNITISED FUND APPROACH TO WITH-PROFIT BUSINESS

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ABSTRACT

The paper traces the history of the development of a with-profit system for a specialist unit-linked office. The marketing problem, to which this was the chosen solution, is discussed and a number of possible future developments are then considered. The second half of the paper is devoted to discussion of the question of matching assets and liabilities for the range of products developed. Although the paper deals with developments in a particular office the authors' intention is to provide a different perspective on the problems associated with conventional with-profit business which will be of more general interest.

KEYWORDS

Asset Shares; Bonus; Matching; With Profits

1. INTRODUCTION

1.1 This paper falls into two distinct parts. In the first we describe the solution to a marketing problem that was adopted by a specialist unit-linked office that wished to enter the with-profits market. We discuss the technical solution chosen, and ways in which this has been developed since and might be developed in the future. In the second part we discuss the question of matching assets and liabilities in the context of this product design, describe the strategy chosen, and discuss some possible alternatives. We hope that this will be of general interest as it provides a different perspective on the problem faced by conventional with-profits offices, and thus brings some of the points into sharper focus.

1.2 Some of the points discussed in this paper we believe to be new, in the sense that a discussion of them has not appeared in print before, but the general principles have been discussed for many years. For example, in a paper by C. E. Barton⁽¹⁾ to the Institute of Actuaries Students' Society, we find the following comments:

"It is suggested therefore that in respect of each participating policy becoming a claim there should be paid a final bonus representing the appropriate share of the equity content of the fund. . . .

The final bonus should reflect the contribution of each policy to the equity content and the stake of each policy throughout its duration. . . .

The principles advocated in this paper bear a strong resemblance to those of unit trusts and equity-linked assurances, various types of which have been introduced in recent years. It is not intended, however, to advocate equity-linked assurances. On the contrary the desire is to combine the traditional life assurance approach with that of the unit trusts to secure the best of each. It is desired to

retain the flexibility of the life office's investment policy whereby it chooses from the widest possible range of investments, whilst the unit trust confines itself to ordinary shares and very often only to certain types of ordinary share. There is also less flexibility in the types of assurance offered under equity-linked schemes."

It is not possible to attribute the genesis of ideas to any particular source, but no doubt the remarks quoted, and many others beside, had some effect.

2. THE PROBLEM

2.1 In 1973 and 1974 the stockmarket was in decline. An office with a direct sales force needed to be able to offer a wider range of products than its existing unit-linked range, but was restricted because a satisfactory solution had not been found to the technical problem of defining the unit component under a whole of life policy. It is worth considering this technical problem before going back to the marketing problem.

2.2 Under the simplest form of unit-linked policy, part of each premium is considered as providing for the life cover, part for expenses and profit, and the remainder available to provide a credit to the unit account. This is usually referred to as the unit component of the premium. Where the policy provides a uniformly decreasing cash sum on death in addition to the value of the units, and matures no later than age 70, it happens that with modern mortality tables the cost of life cover changes very little from year to year. As a result the unit

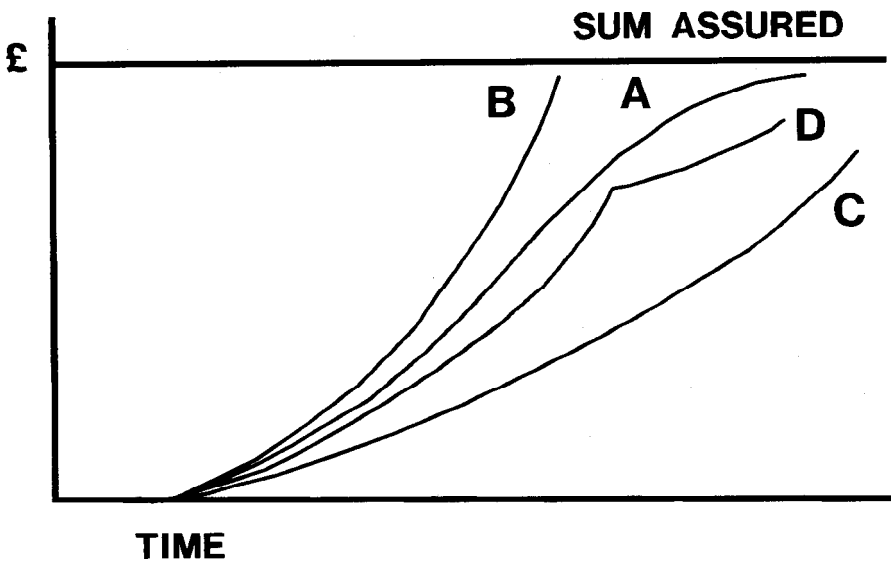


Figure 2.3

component can be fixed at a constant amount (except in the first year or two, to allow for initial expenses), with little distortion to the natural pattern of margins. Another way of expressing this is to say that the curve representing the reserve for such an endowment assurance is very similar to that for a capital redemption policy.

2.3 When we turn to the whole life policy, the curve representing the reserve starts off looking the same, but then flattens out. In Figure 2.3 it is represented by curve A. The result of adopting a level unit component will give us a curve that looks like curve B or curve C. In the first case the resulting premium will be too high to be competitive. In the second case the fit is not good, and the result will be that the unit component will be unattractively low compared to the premium, and substantial sterling reserves will be required. Providing for premiums to cease at some relatively advanced age will produce curve D, which is an improvement, but not a perfect solution. To reproduce curve A requires a varying unit component that at the higher ages becomes negative. That would appear to be a complication that even the best prepared agent would not wish to try to explain to a client, even assuming the office had explained it satisfactorily to the agent in the first place.

2.4 The modern solution to this problem is to credit the whole of the net premium to the unit account in the first instance and then cancel a number of units each year to pay for the life cover. No doubt the actuaries who designed these contracts will have retired before the policyholders start writing in to enquire why the number of units cancelled is greater than the number credited. Growth in the unit price should mean that the value of the account has increased, but it is not an easy point to explain.

2.5 The marketing problem was the altered attitude to investment risk on the part of the prospective policyholders. For a number of years their concern had been to participate in the profits of equity investment, and the concomitant risk was generally ignored. Suddenly the risk was seen as more important than the potential gain, and the demand was for stability and guarantees.

2.6 Discussion of the risk to an office of giving guarantees on unit-linked contracts had advanced to the point where it was accepted that a level of guarantee that was sufficiently attractive to the customer would be too onerous for the office. Policies linked to Building Society deposits or other deposit accounts had been developed, but did not appear to offer a solution, since they could not be offered on terms that were attractive to the customer and would at the same time provide adequate margins to the office.

2.7 The next question considered was whether a range of conventional non-profit policies could be developed to fill the gap. Sales of non-profit policies had been declining for many years, despite the fact that there was keen competition. It was quickly concluded that it would not be possible to produce a product range that would be both competitive and profitable.

2.8 Finally, the question of launching a range of conventional with-profits policies was considered. The problem here would be one of credibility. Why

should anyone believe that an office starting from scratch would be able to declare higher bonuses than another office with more than 100 years of experience? There was also the small matter of adequate capital.

3. THE SOLUTION

3.1 Given that a direct attack on the main market looked unattractive, two questions were asked. Was there a niche in the market that could be filled profitably? What expertise did the company possess that would give it an advantage in this part of the market?

3.2 The answer to the second question was experience in operating unitised funds and systems for keeping track of individual unit accounts. Reputation for investment expertise was also an important asset.

3.3 The niche identified was in the wide margin between the premiums generally charged for with-profits policies and those for their non-profit equivalents. This had evolved as a result of the reluctance to reduce levels of reversionary bonus over many years, and the consequent level of bonus loading in the premium scales. Was it possible to design a range of with-profits policies with premiums at an intermediate level as a result of having no bonus loading? Yes, was the answer, provided there were no reversionary bonuses. There could still be a terminal bonus, and the unit-linking technology would provide a means of determining its amount. It would vary according to the history of the individual policy, and the market value of the investments at the date of claim. This would provide a positive selling point by contrast to the insensitivity of the terminal bonus systems of the conventional offices, and the problem of discontinuity in policy proceeds at the time of change in bonus rates.

3.4 The essence of the new contract was that the policy would provide a guaranteed sum assured, and this would be supplemented by a terminal bonus dependent on the investment earnings of the fund. The fund would be managed in the same way as for conventional life assurance business: the first priority would be to invest to ensure that the guarantees would be met, and the secondary objective would be to achieve the best possible investment performance. This is the most important way in which the product differs from a linked contract.

3.5 Although the investment policy is determined with a view to covering the guarantees, there may, of course, be occasions when policies mature with guaranteed benefits that exceed their share of the unitised fund. In this case the balance is paid by the fund, at the expense of the continuing policyholders. This is the other difference between this contract and a linked contract, where the cost of any guarantee would fall on the shareholders or another class of policyholders. It is important that this feature is made clear to prospective policyholders.

3.6 Effectively each generation is providing a guarantee to previous generations, and benefiting from a guarantee by succeeding generations, with the investment managers seeking to minimise the cost in any event. This gives rise to the thought that perhaps each generation that takes out more than the

guaranteed benefits should leave behind a sum representing a retrospective premium to pay for the value of the guarantee enjoyed. The position is no different in a conventional with-profits fund, and perhaps the concept of the 'estate' which is passed on from one generation to the next should be considered in this light.

3.7 In fact, we have not yet developed a satisfactory model for assessing an appropriate level for this retrospective premium, but an element of it has been introduced by the adoption of a smoothing formula for the unit price used to determine the terminal bonus. This was considered to be desirable in any case. The offer price used to calculate the number of units to be credited to the internal account as each premium is paid is calculated weekly on a market value basis. A 'claim price' is then calculated from the current offer price and the previous claim price (an exponential smoothing process). The claim price may exceed the offer price at times, but, because the growth assumption in the smoothing formula is conservative, it normally lags the offer price. The terminal bonus payable on death is calculated as the excess of the value of the unit account at the claim price over the value of the internal reserve. On maturity the terminal bonus is the excess of this value over the guaranteed sum assured. Surrender values are based on an asset share calculated on whichever is the lower of the offer and the claim price.

3.8 It was decided that the basis of apportionment of the profits should be that the office would take all the risk and profits from mortality and expenses, and initially the first $\frac{1}{2}\%$ p.a. of the investment surplus. All of the rest of the investment surplus would accrue to the policyholder. The interest rate basis for premiums and internal reserves was fixed at $3\frac{1}{2}\%$ p.a. for life assurance products, and the policyholder could therefore be told that the terminal bonus would represent the investment earnings on the fund in excess of $3\frac{1}{2}\%$ p.a. after charges. Other participation systems would have been possible, and we return to this subject later.

4. THE TECHNICAL STRUCTURE

4.1 The implication of this structure was that we needed to identify the amount to be invested out of each premium such that if the fund earned exactly $3\frac{1}{2}\%$ p.a. after charges, the value of the unit account maintained for the policy would at any time equal the net premium reserve. Thus, for an annual premium policy, the investment component $IC(t)$ in year t is defined as:

$$IC(t) = V(t+1)/1.035 - V(t)$$

where $V(t)$ represents the net premium reserve at duration t .

For monthly premium policies it was decided to work from the same reserve calculations, but to increase the resulting investment components to allow for the fact that the investment would be made $5\frac{1}{2}$ months later on the average. The annual and monthly gross premiums were developed separately from the profit-testing model, and do not bear a direct relationship to one another.

4.2 A Zillmer adjustment is incorporated so that the theoretical initial reserve is negative. In some cases the first anniversary reserve is also negative, as is the case in the example set out in Table 4.1, and the second anniversary reserve may also be negative. These values are set to zero for the purpose of calculating the investment component, and also for the statutory valuation, although the negative values have to be preserved in the record.

4.3 The system that has been adopted has been to input to the computer record the initial (negative) reserve when the policy is put into force, together with the corresponding adjusted net premium. The next anniversary reserve is then calculated from the formula:

$$V(t+1) = ((V(t) + P) \times 1.035 - S \times q(t)) / (1 - q(t)).$$

This value is recorded. The investment component for the year is then calculated and recorded. When the next anniversary is reached the process is repeated and the new investment component calculated and recorded.

4.4 The advantage of this system is that it is universal. The same formula applies whether the contract is whole of life, endowment assurance, term assurance, or any variation. This simplifies the programming. It also provides for an automatic adjustment to the next reserve value, and hence to the investment component, if the value of the death benefit should be varied.

4.5 The number of units in the fund attributed to the policy is also held on the computer record. The potential terminal bonus can then be calculated at any time by valuing the unit account and deducting the value of the reserve. The reserve at any time is determined by discounting the next anniversary reserve allowing for any monthly premiums due in the current policy year.

4.6 Table 4.1 sets out the calculations involved as far as the identification of the investment components and the cost of life cover, and thence the premium and fund margins. Thereafter gross premiums can be developed using the same cash flow profit testing methods as are used for unit-linked contracts. We have not covered this ground as it has been dealt with adequately in other papers.^{(2),(3)}

4.7 This analysis implicitly assumes that the internal reserves generated will be adequate for the statutory valuation. This assumption has to be tested against the valuation regulations. For example, the actuary must be satisfied that the margin between the gross and net premiums will be sufficient to provide for future expenses. The original series was launched before the valuation regulations were developed, and the Zillmer adjustments chosen were in some cases in excess of those now permitted, so an adjustment has been necessary.

4.8 A more significant problem is the resilience test. The net premium reserve is very insensitive to the interest rate assumption in the early years of the policy. The effect on the value of the fund of a 25% drop in market values for the equities and a 3% increase in the yield on the fixed interest stocks will significantly outweigh any release of reserve as a result of assuming a higher interest rate basis. To the extent that there is a surplus on an individual policy it can be offset against the additional reserve required, but there is likely to be a strain in the early years when any surplus will be small.

Table 4.1

*25 Year Endowment Assurance by annual premium.
 Male life age 40 at entry—Sum Assured £10,000.
 Net Premium calculated on A1967/70 Ult. at 3½%.
 Zillmer Adjustment 3½% of Sum Assured.
 Assumed net composite unit growth rate = 8%.
 Assumed mortality experience = 75% of A1967/70 Ult.*

Year	1	2	3	24	25
1,000 q_x	1.44	1.62	1.83	19.65	21.74
Unit Offer Price (pence)	100.00	108.00	116.64	587.15	634.12
Trial Office Premium	309.46	309.46	309.46	309.46	309.46
Net Premium	294.72	294.72	294.72	294.72	294.72
Reserve @ Start	(350.00)	(71.74)	214.89	8,767.65	9,367.11
Reserve @ End	(71.74)	214.89	510.07	9,367.11	10,000.00
Investment (£)	0.00	207.63	277.93	282.70	294.72
Units Credited (u)	0.00	192.25	238.28	48.15	46.48
Unit Fund (u)	0.00	192.25	430.53	2,718.24	2,764.72
Value of Fund (£) (at year end)	0.00	224.24	542.34	17,236.87	18,934.12
Average Sum at Risk	10,000.00	9,788.77	9,498.63	792.63	170.54
Cost of Death Claims	10.88	11.99	13.13	14.84	6.48
Premium Margin	298.58	89.84	18.40	11.92	8.26
Fund Margin (½%)	0.00	1.12	2.71	86.18	94.67
TOTAL MARGIN	298.58	90.96	21.11	98.10	102.93

4.9 In presenting the result of the valuation in the returns to the DTI it is necessary to show the value of the sum assured and the value of the net premiums separately. One advantage of the net premium method is that only one of these needs to be calculated directly, and the other can then be derived. This particular advantage has been eroded by the developments discussed in §§ 4.7 and 4.8. The office subsequently developed independent valuation programmes to deal with the requirements to allow valuation at other rates of interest for resilience testing and to provide internal controls on the data.

4.10 We can now consider the advantages that this approach has brought us. We have a general system that will enable us to develop products that may be complex in their inner working, but are simple to present to prospective customers. We have an automatic calculation of the asset share for each policy without needing to build additional systems or make broad approximations. We have a ready measurement of the investment performance of the fund by reference to the internal unit prices calculated, and we have the ability to calculate the projected maturity proceeds accurately and easily on any chosen investment yield assumptions. It is ironic that recent changes in the regulatory regime have meant that we are not able to use the latter facility.

5. RECENT DEVELOPMENTS

5.1 We commented in §4.4 that the system adopted would allow the death benefit to be altered and still produce an appropriate reserve value. Ten years passed before we turned our attention to the problems of designing a variable life contract using this structure. By that time we had the advantage that with life assurance premium relief gone we could get away from the constraints of the qualifying policy rules, but we had the Valuation Regulations to consider instead. In view of this, we redefined our internal reserve basis so that the results would be suitable for direct use in a statutory valuation.

5.2 The objective was to provide permanent life assurance cover allowing the policyholder to anticipate future earnings on the fund by choosing to pay a lower rate of premium, subject to regular review. Most of the unit-linked variable life contracts provide for a first review after 10 years, and every 5 years thereafter. We decided to go for a regular 5-year review. In common with most other such contracts the review is annual after age 75.

5.3 Most unit-linked variable life contracts also allow a very wide range for the sum assured relative to the premium, so that the policy might effectively be anything between an endowment assurance and a term assurance. We decided that our policy was to be aimed specifically at the life assurance protection market and fixed the minimum sum assured as equivalent to that for the basic whole of life policy with the same premium. The maximum is just short of that for a 5-year term assurance as a result of the decision to provide a reserve at the review date equal to one month's premium. This provides for the cost of the administrative work necessary at the review date, whether or not the policyholder decides to continue the contract.

5.4 The process of setting up a record for a new policy starts with the chosen premium. This determines the basic sum assured that could be guaranteed for life, which in turn determines the net premium and the initial reserve. These values are fixed regardless of the actual death benefit chosen by the policyholder. The system will then calculate the reserve values in successive years, and from these determine the amounts to be invested in the fund, which will reflect the level of life cover provided. The method is as set out in §§4.1 and 4.3.

5.5 If the level of life cover chosen is more than the basic level, the reserves generated by this retrospective basis will not, of course, equal the prospective reserves based on the assumption that this level of cover will apply for the whole of life. That is because this level will not be maintained after the review date if the fund has only earned $3\frac{1}{2}\%$ p.a. The returns to the DTI require the reserve to be calculated on a prospective basis. The solution is to calculate the level of sum assured that can be supported by $3\frac{1}{2}\%$ p.a. earnings after the review date, given the net premium, initial reserve and level of cover chosen for the first 5 years. This level of sum assured is then guaranteed from the review date onward. The prospective and retrospective reserves are, as a result, identical.

5.6 We also needed a mechanism to reflect the actual past performance of the

fund at the review date, in order to set the limits on the sum assured that could be chosen for the next period. The chosen procedure identifies the excess of the individual's fund value (calculated on the claim price—see § 3.7) over the reserve at the review date, and calculates the reversionary bonus that this will support. This is added to the previously determined guaranteed sum assured to give the minimum sum assured for the ensuing period. As a result, the internal reserve is increased by the cost of the bonus to equal the fund value. The reversionary bonus is only used for this limited purpose. It is not separately identified once the new level of cover has been chosen. This value, together with the net premium and the required minimum reserve at the next review date determine the maximum sum assured that may be chosen for the next period. When a value between these limits has been selected, the guaranteed sum assured to apply after the next review date is calculated, so that the reserve will again be reproduced on a prospective valuation basis.

5.7 There were a number of other points of detail that had inevitably to be decided, dealing with premium increases and decreases, for example, and the extended term option that allows the value of the policy to be used up in providing term assurance at a chosen level. The one complication that we think will be found interesting is our solution to the problem of providing joint-life assurance with the sum assured payable on the second death.

5.8 If a joint-life second death policy is issued on a non-profit basis, the office can hold a reserve based on the existence of the two lives until the first dies. If it is informed of this fact, it will then increase its reserve to that appropriate to a single life, with the original net premium that was appropriate to the joint life policy. We decided to follow the logic of this procedure. The implicit charge for life cover in the calculation of each reserve value from its predecessor is for the increase in reserve that would be required if one of the two lives dies, and for the sum at risk if both die. When we are advised of a death, we calculate the required increase in reserve and increase the individual's fund by this amount. It will be seen that the sooner we are advised of the first death, the longer there is for the addition to the fund to earn surplus, and so the greater the terminal bonus paid on the second death will be.

5.9 If the chosen sum assured is at or near the minimum, this works perfectly well. The problems arise with the determination of the maximum sum assured. The level of cover that can be supported by a given premium on a second death term assurance is very high in comparison with a single life term assurance. At the review date following the first death the survivor will be faced with either a significant reduction in sum assured or a large increase in premium. There may be some consolation in the fact that the surrender value has increased significantly, but if the contract was the right choice in the first instance, it is no less appropriate once the first death has occurred. In practice, we have thought it right to put an arbitrary limit on the maximum sum assured to minimise the extent of this problem.

5.10 In the event of simultaneous deaths, the sum assured is payable together

with the value of bonus as for a single life claim. It was necessary to adapt reinsurance arrangements to allow for this small risk of a large payment on policies that would not otherwise be reassured. Joint life second death processing also led us to adapt the Elphinstone and Lindsay method for calculating last survivor annuity values, to limit the size of annuity tables held on the system⁽⁴⁾.

5.11 We have also developed pensions products on the same principles. The first was a self-employed deferred annuity contract, providing a guaranteed minimum annuity. This is a hybrid, in that the investment is in the with-profits fund until vesting, when the individual's fund is used to buy a non-profit annuity. This is the point of time at which the distribution of surplus occurs for the purpose of monitoring the relative amounts of the distributions to policyholders and shareholders.

5.12 More recent developments have required us to find a way of accommodating variable contributions to pension contracts. Our solution has been to design our own version of the 'unitised with-profit' contract. A unit-linked version of the contract was designed first, and the unit components and charging structure for this were settled, with the underlying fund charge being kept at the level applicable to the with-profits fund. The with-profits version was then specified in line with this structure, but with the addition of an accruing guarantee. Each contribution in the first year of the contract, and each contribution representing an increase over the previous maximum annual rate of contribution adds an amount to the guarantee equal to its value. Subsequent contributions add to the guarantee an amount equal to their value plus interest at 5% p.a. up to the vesting date, at which the guarantee applies.

6. FUTURE DEVELOPMENTS

6.1 We believe that there is still a long way that one could go with this concept. For example, we originally chose to design a policy with no annual reversionary bonuses because the objective was to achieve a low level of premium relative to the guaranteed sum assured. But this is not fundamental to the system, and if it were desirable for marketing purposes, a new series with reversionary bonuses could readily be developed. These could themselves be guaranteed, or they could be declared each year. They might be at a uniform rate, or they might not be.

6.2 A further interesting development would be to design a new series where the mortality and expense profits were also shared between the policyholders and the shareholders. It would simply be a matter of using a heavier mortality table for the development of the premiums and the calculation of the internal reserves, and including heavier expense loadings. The investment in the with-profits fund would then reflect the mortality cost saving relative to the valuation basis, and an arbitrary addition for the expense saving. At this point one is getting close to the North American system of profit distribution that recognises the contribution to surplus by the individual policy, with the difference that the resulting cash bonus

would be automatically reinvested rather than paid out in cash. The system would also be easier to administer than the classic contribution system.

6.3 Finally, there are some interesting possibilities in response to some of the current issues. For example, instead of charging differential premiums for smokers and non-smokers, dependent on status at the time of the proposal, one could have a single premium rate and differential bonuses. It would be possible to ask non-smokers to reconfirm their status at, say, 5-year intervals, with the possibility of altering their status for the future, if necessary, without affecting the profits accrued in the past. Likewise, one could develop differential bonus scales for those who were prepared to provide evidence of being HIV negative, and those who were not, to supplement other anti-AIDS underwriting policies, or simply for males and females for the age ranges where the mortality risk is significantly different. Another interesting possibility would be the ability to pay a chosen level of commission up to some ceiling, with any saving coming out in the terminal bonus. A step has already been made in this direction in that policies issued to staff are credited with the commission that would otherwise have been paid.

7. INVESTMENT POLICY

7.1 We can now turn our attention to the questions of investment strategy and matching. In the past, discussions of matching assets to liabilities for with-profits policies have started from the basis of investing in fixed-interest securities, and have then considered how much of the fund could safely be moved into equities. We have started from the other end, assuming that the fund will be invested in equities unless there is a demonstrable need to hold particular fixed-interest investments in order to match guaranteed benefits.

7.2 There are two reasons for this. The first is the culture of the company that had previously sold only unit-linked contracts, and held the belief that, in the long term, equity investment will provide a better return than fixed interest investment. The second is that it is impossible to immunise a new fund in a time of high interest rates, when the effective term of even an irredeemable stock is very short relative to the liabilities. We coined the term 'hyper-irredeemable' to describe the kind of stock we would need. It would need to have a dividend which increased at a rate close to the prevailing yield.

7.3 An equity investment may be expected to pay an increasing dividend, and although it is not guaranteed, it is otherwise a better fit for the required investment than a dated stock with a fixed dividend. The income from a portfolio of equity investments will be more stable than that from a single investment, and we noted the conclusion of the Maturity Guarantees Working Party⁽⁵⁾ that the income from an equity portfolio is significantly more stable than its market value. We concluded that, during the initial build-up of our fund, equity investment and property investment, which share the required attributes, were most appropriate.

7.4 We realised that the day would come when this simple conclusion would

be insufficient and that we would need a mechanism for determining what further guidance the investment managers should be given. There are two risks that we have to consider. The first is that yields available on investments will fall so that we will not be confident of being able to match the guaranteed terms in normal conditions. The second is that market values will fall significantly just at the point when substantial guaranteed benefits become payable. This is discussed in Section 8.

7.5 The point at which yields have fallen so far that one could not guarantee a return of $3\frac{1}{2}\%$ p.a. net of charges on a regular premium contract can only be a matter of judgement. As a guide we looked at the return on a ten-year endowment assurance, issued at age 40, assuming $5\frac{1}{2}\%$ p.a. composite net growth in the internal unit price, which would require $5\frac{1}{2}\%$ p.a. net of tax on the underlying investments, assuming a charge of $\frac{1}{2}\%$. This gave a terminal bonus equal to 8.4% of the sum assured, which we felt was about the minimum that one should envisage: 10% would be more comfortable. At this level a substantial part of the fund might have to be in fixed-interest securities as these policies approached maturity, and there might therefore be too great a degree of conflict between this matching requirement and the interests of the holders of the longer-term policies.

7.6 If this point is reached, there should be capital gains on the existing investments, corresponding to the fall in yield, which will more than compensate for the future loss of income for those policies that have been in force long enough to require a substantial reserve. The problem will be with the recently issued policies. It may be appropriate to provide an investment reserve out of the 'windfall' profit, to prevent it all being distributed to the earlier maturities, leaving a shortfall on the later ones.

8. MATCHING STRATEGY—THEORETICAL MODEL

8.1 We decided to address the reverse problem, that is the risk of the guarantees being uncovered by a fall in the market value of the fund, by paid-up matching. The first stage is to schedule the business in force by year of maturity for endowment assurances and attained age for whole of life contracts. The total of the internal reserves and the total current asset share in terms of units is recorded for each sub-group. Theoretical paid-up values are then calculated, ignoring any penalties that would be imposed in practice. From these figures the expected guaranteed death and maturity payments for each year are calculated, together with the corresponding number of units that would be released from the fund. We can then calculate future unit values corresponding to various investment strategies and outcomes and the levels of terminal bonus that would result.

8.2 The approach is to look at each year in two stages. The first is to look at the 'normal values', which assume that the prices of the equity investments progress steadily along a trend line corresponding to the assumed growth rate. The

resulting terminal bonuses and the percentages that they will bear to the guaranteed sums are calculated. Next, we calculate the 'critical values' which assume that share prices have followed the trend line up to the beginning of that year, and then fall by 25%. We assume that in these circumstances the dividends on the equity investments will fall by 10%, and that the redemption yield on any fixed-interest stocks will increase by 3 percentage points. We then calculate the resulting terminal bonus or the shortfall of the asset share from the guaranteed sum.

8.3 In Table 8.1 we show the results obtained for a theoretical block of business consisting entirely of 10-year endowment assurances where the whole fund is invested in ordinary shares. To keep the arithmetic simple they are all assumed to be annual premium contracts effected on 1 July, and all dividends are assumed to be received, and all transactions to take place on that date each year. Provision for tax on capital gains is assumed to be made at 25% in the pricing of the units, and tax at that rate is assumed to be payable immediately on realised gains. Where there is a capital loss, a 15% credit has been given in the unit pricing. We discuss the justification for this figure in § 8.4. For the 'normal values' the equities are assumed to grow in value at 8% p.a. and pay a dividend at the year-end worth 3% of their market value ($2\frac{1}{4}\%$ net). Gilt-edged investments with a 10% coupon are assumed to be available at par, and the RPI is assumed to grow at 6% p.a. For the 'critical values', the equities are assumed to drop in price by

Capital Growth Rate	8% p.a.
Gross Dividend Yield	3% p.a.
Normal Gilt Redemption Yield	10% p.a.
R.P.I. Increase	6% p.a.
Tax Rate on Income	25%
Tax Rate on Capital Gains	25%
Tax Credit on Losses	15%

Critical Values:

Market Values of Equities	75%
Fall in Dividend Income	10%
Redemption Yield on Gilts	13% p.a.

Year of Maturity	Paid Up Value	Associated Units
1	9,100	10,000
2	8,200	8,400
3	7,300	7,100
4	6,400	6,000
5	5,500	5,000

These figures are common to Tables 8.1–8.6.

Table 8.1

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up Value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	42,000-00	44,520-00	38,238-88	32,319-22	26,658-70	21,216-16
<i>Normal Values</i>						
Equities	50,000-00	54,000-00	47,256-51	40,694-46	34,200-41	27,731-73
CGT Reserve	(2,000-00)	(2,370-00)	(2,254-41)	(2,093-81)	(1,885-43)	(1,628-89)
Gilts	0-00	0-00	0-00	0-00	0-00	0-00
Dividend Income		1,215-00	1,063-27	915-63	769-51	623-96
Gilt Interest		0-00	0-00	0-00	0-00	0-00
	48,000-00	52,845-00	46,065-37	39,516-28	33,084-49	26,726-80
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100-00	110-09	121-22	133-50	147-04	161-98
Maturity Proceeds		11,009-38	10,182-87	9,478-57	8,822-53	8,099-03
Bonus		1,909-38	1,982-87	2,178-57	2,422-53	2,599-03
Bonus Percentage		20-98	24-18	29-84	37-85	47-26
Gilts Matured		0-00	0-00	0-00	0-00	0-00
Equities Sold		10,243-97	9,576-45	9,027-42	8,522-88	7,941-53
Reduction in CGT Base		8,445-59	7,749-04	7,169-51	6,643-45	6,075-67
<i>Critical Values</i>						
Equities		40,500-00	35,442-38	30,520-85	25,650-30	20,798-80
CGT Reserve		603-00	419-47	269-76	151-26	62-60
Gilts		0-00	0-00	0-00	0-00	0-00
Dividend Income		1,093-50	956-94	824-06	692-56	561-57
Gilt Interest		0-00	0-00	0-00	0-00	0-00
		42,196-50	36,818-80	31,614-67	26,494-12	21,422-97
Unit Price (p)		87-91	96-89	106-81	117-75	129-84
Maturity Proceeds		8,790-94	8,138-89	7,583-25	7,065-10	6,491-81
Bonus		0-00	0-00	283-25	665-10	991-81
Guarantee Cost		309-06	61-11	0-00	0-00	0-00
Bonus Percentage		0-00	0-00	3-88	10-39	18-03
New Unit Price (p)		87-10	96-69	106-81	117-75	129-84

25%, while the dividend income on the portfolio drops by 10% and the gilts are assumed to go to a 13% p.a. gross redemption yield. These otherwise arbitrary figures will be recognised as those chosen by GAD for their yardstick in assessing the adequacy of mismatching reserves.

These assumptions are summarised on the previous page, and the theoretical paid-up values and associated unit holdings are stated by year of maturity for the next five years.

8.4 The problem with pricing the units to include credit for a potential tax rebate in respect of a capital loss is that it will only be of value as an offset against

Table 8.2

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up Value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	34,999·00	37,098·94	35,985·45	32,149·29	26,518·53	21,104·61
<i>Normal Values</i>						
Equities	41,667·00	45,000·36	44,473·29	40,481·97	34,021·83	27,586·94
CGT Reserve	(1,667·00)	(1,975·35)	(2,121·96)	(2,083·17)	(1,875·82)	(1,620·58)
Gilts	8,000·00	8,000·00	2,300·00	0·00	0·00	0·00
Dividend Income		1,012·51	1,000·65	910·84	765·49	620·71
Gilt Interest		600·00	172·50	0·00	0·00	0·00
	48,000·00	52,637·51	45,824·48	39,309·64	32,911·50	26,587·06
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100·00	109·66	120·59	132·80	146·27	161·13
Maturity Proceeds		10,966·15	10,129·62	9,429·00	8,776·40	8,056·69
Bonus		1,866·15	1,929·62	2,129·00	2,376·40	2,556·69
Bonus Percentage		20·51	23·53	29·16	37·13	46·49
Gilts Matured		5,700·00	2,300·00	0·00	0·00	0·00
Equities Sold		3,821·39	6,989·99	8,980·28	8,478·37	7,900·06
Reduction in CGT Base		3,150·40	5,655·93	7,131·80	6,608·52	6,043·72
<i>Critical Values</i>						
Equities		33,750·27	33,354·97	30,361·48	25,516·37	20,690·20
CGT Reserve		502·30	394·57	268·17	150·32	62·16
Gilts		7,938·94	2,300·00	0·00	0·00	0·00
Dividend Income		911·26	900·58	819·76	688·94	558·64
Gilt Interest		600·00	172·50	0·00	0·00	0·00
		43,702·77	37,122·63	31,449·41	26,355·64	21,311·00
Unit Price (p)		91·05	97·69	106·25	117·14	129·16
Maturity Proceeds		9,104·74	8,206·05	7,543·61	7,028·17	6,457·88
Bonus		4·74	6·05	243·61	628·17	957·88
Guarantee Cost		0·00	0·00	0·00	0·00	0·00
Bonus Percentage		0·05	0·07	3·34	9·82	17·42
New Unit Price (p)		91·05	97·69	106·25	117·14	129·16

subsequent capital gains, and we cannot be sure that these will occur. For this reason, we believe that the normal practice in pricing units of internal funds used for linked policies is not to allow any credit for capital losses. The question is one of equity between generations, and there does not appear to be a right answer, but we feel that it would be wrong to give full credit, and equally wrong to give no credit, as our fundamental assumption is that equity investment will be profitable in the long run. The choice of 15% is a compromise. If the loss is large enough for the guarantee to come into play, of course, the point is academic, as the amount paid and the effect on the fund will be the same either way.

Table 8.3

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	9,362.00	9,923.72	9,112.10	8,369.91	7,501.92	6,465.86
<i>Normal Values</i>						
Equities	11,146.00	12,037.68	11,261.72	10,539.61	9,624.86	8,452.13
CGT Reserve	(446.00)	(528.49)	(537.40)	(542.43)	(530.73)	(496.57)
Gilts	37,300.00	37,300.00	31,100.00	25,300.00	20,000.00	15,200.00
Dividend Income		270.85	253.39	237.14	216.56	190.17
Gilt Interest		2,797.50	2,332.50	1,897.50	1,500.00	1,140.00
	48,000.00	51,877.54	44,410.20	37,431.83	30,810.68	24,485.73
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100.00	108.08	116.87	126.46	136.94	148.40
Maturity Proceeds		10,807.82	9,816.99	8,978.58	8,216.18	7,419.92
Bonus		1,707.82	1,616.99	1,678.58	1,816.18	1,919.92
Bonus Percentage		18.77	19.72	22.99	28.38	34.91
Gilts Matured		6,200.00	5,800.00	5,300.00	4,800.00	4,300.00
Equities Sold		1,610.16	1,502.82	1,627.71	1,798.81	1,901.46
Reduction in CGT Base		1,327.40	1,215.96	1,292.63	1,402.05	1,454.61
<i>Critical Values</i>						
Equities		9,028.26	8,446.29	7,904.71	7,218.64	6,339.09
CGT Reserve		134.32	99.87	69.78	42.49	19.01
Gilts		34,831.73	29,243.85	23,961.55	19,087.55	14,624.94
Dividend Income		243.76	228.05	213.43	194.90	171.16
Gilt Interest		2,797.50	2,332.50	1,897.50	1,500.00	1,140.00
		47,035.57	40,350.56	34,046.97	28,043.59	22,294.20
Unit Price (p)		97.99	106.19	115.02	124.64	135.12
Maturity Proceeds		9,799.08	8,919.60	8,166.67	7,478.29	6,755.82
Bonus		699.08	719.60	866.67	1,078.29	1,255.82
Guarantee Cost		0.00	0.00	0.00	0.00	0.00
Bonus Percentage		7.68	8.78	11.87	16.85	22.83
New Unit Price (p)		97.99	106.19	115.02	124.64	135.12

8.5 The figures in Table 8.1 show for 'normal' conditions a terminal bonus growing from just over 20% to just under 50% over the next 5 years, and the trend continues for later maturities. The 'critical' values show a significant cost for maturities in year 1 or a lesser cost in year 2, and no problem thereafter. Neither case would be serious in terms of the solvency of the fund, the effect on the unit price being 0.8p the first year or 0.2p the second, but some switching into a fixed-interest holding is indicated. The judgement has to be made in the light of the fact that we are not considering a 'worst case' scenario, but a reasonably likely variation.

8.6 Table 8.2 shows the result of switching just enough of the fund into fixed-interest stocks maturing in the next 2 years to prevent the guarantees costing anything at the chosen critical level. Surprisingly 16% of the fund has to be switched, even though the potential problem appeared to be small. Because of the short term of these investments, however, the longer term effect is small, the unit price 5 years later being only $\frac{1}{2}\%$ less as a result of the restructuring of the portfolio.

8.7 Simply covering the guarantee is the minimum that is required, and leads on to the question of policyholders' reasonable expectations. It is difficult to decide what this means in the context of terminal bonuses, but a bonus of only 0.05% would be difficult to justify. We therefore looked next at the changes that would need to be made to the portfolio to produce a bonus of at least 10% in the conditions envisaged. It turned out that to achieve this would require almost the entire portfolio to be switched into fixed-interest stocks, and we felt that this would be equally unreasonable.

8.8 In particular, a minimum bonus of 10% in year 1 would require more fixed-interest stocks maturing in that year than the policy proceeds payable, and we felt that this represented a natural limit. Table 8.3 shows the effect of switching sufficient of the fund into fixed-interest stocks so that each year's policy proceeds are matched by dividends and interest plus redemption proceeds of fixed-interest stocks. Over 75% of the fund is switched into fixed-interest stocks,

Table 8.4

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up Value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	42,000.00	44,520.00	38,238.88	32,571.44	26,866.74	21,299.39
<i>Cyclical Values</i>						
Equities	50,000.00	54,000.00	35,442.38	41,012.04	43,084.13	27,840.51
CGT Reserve	(2,000.00)	(2,370.00)	419.47	(2,110.15)	(4,054.35)	(1,635.28)
Gilts	0.00	0.00	0.00	0.00	0.00	0.00
Dividend Income		1,215.00	1,063.27	922.77	775.51	626.41
Gilt Interest		0.00	0.00	0.00	0.00	0.00
	48,000.00	52,845.00	36,925.13	39,824.66	39,805.30	26,831.64
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100.00	110.09	97.17	134.54	176.91	162.62
Maturity Proceeds		11,009.38	8,162.40	9,552.54	10,614.75	8,130.80
Bonus		1,909.38	0.00	2,252.54	4,214.75	2,630.80
Guarantee Cost		0.00	37.60	0.00	0.00	0.00
Bonus Percentage		20.98	0.00	30.86	65.86	47.83
Gilts Matured		0.00	0.00	0.00	0.00	0.00
Equities Sold		10,243.97	6,961.80	9,097.87	10,861.31	7,972.68
Reduction in CGT Base		8,445.59	7,511.10	7,225.46	6,772.98	6,099.50

and the resulting bonuses in years 1 and 2, corresponding to the critical values are 7.68% and 8.78%. Thereafter the bonuses always exceed 10%. The cost in terms of fund performance is a reduction of $8\frac{1}{2}\%$ in the unit price over 5 years, at the 'normal' level.

8.9 This assessment of the cost is a direct result of the assumptions made, one of which is a smooth progression in the market values of the equity investments. There is an inherent contradiction between this and the assumption that prices might fall by 25%. In particular, it ignores the effect of prices being 25% above the trend line at some intermediate point. In the next two tables, we therefore look at the effect of assuming values for the equities on the trend line at the first, third and fifth anniversaries, 25% down with a redemption yield on the fixed interest stocks of 13% p.a. at the second anniversary and 25% up with a redemption yield of 7% p.a. at the fourth anniversary. In these projections we have assumed that the dividends on the equity investments progress smoothly and do not drop 10% as assumed for the 'critical values' above.

8.10 Table 8.4 shows the all equity portfolio as in Table 8.1. The unit price in year 2 of 97.17p is slightly higher than the corresponding 'critical value' in Table 8.1 as a result of the higher dividend assumed. The unit pricing principles adopted would lead one to expect to see identical values for years 1, 3 and 5. In fact, Table 8.4 shows a value of 162.62 in year 5 against 161.98 in Table 8.1. The reason for this discrepancy is the provision for tax on the capital loss in year 2 at

Table 8.5

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up Value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	9,362.00	9,923.72	9,112.10	9,054.01	8,066.21	6,610.05
<i>Cyclical Values</i>						
Equities	11,146.00	12,037.68	8,446.29	11,401.06	12,936.04	8,640.61
CGT Reserve	(446.00)	(528.49)	99.87	(586.76)	(1,217.46)	(507.64)
Gilts	37,300.00	37,300.00	29,243.85	25,300.00	21,018.30	15,200.00
Dividend Income		270.85	253.39	256.52	232.85	194.41
Gilt Interest		2,797.50	2,332.50	1,897.50	1,500.00	1,140.00
	48,000.00	51,877.54	40,375.90	38,268.32	34,469.73	24,667.38
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100.00	108.08	106.25	129.28	153.20	149.50
Maturity Proceeds		10,807.82	8,925.20	9,179.23	9,191.93	7,474.96
Bonus		1,707.82	725.20	1,879.23	2,791.93	1,974.96
Guarantee Cost		0.00	0.00	0.00	0.00	0.00
Bonus Percentage		18.77	8.84	25.74	43.62	35.91
Gilts Matured		6,200.00	5,800.00	5,300.00	4,800.00	4,300.00
Equities Sold		1,610.16	528.89	1,818.81	2,935.33	1,955.43
Reduction in CGT Base		1,327.40	570.58	1,444.38	1,830.31	1,495.90

Table 8.6

	Initial Values	Year of Maturity				
		1	2	3	4	5
Paid-up value		9,100	8,200	7,300	6,400	5,500
Unit Holding		10,000	8,400	7,100	6,000	5,000
CGT Base	9,362.00	9,923.72	9,112.10	7,877.59	7,095.83	6,571.10
<i>Cyclical Values</i>						
Equities	11,146.00	12,037.68	14,077.15	9,919.68	6,827.89	8,589.69
CGT Reserve	(446.00)	(528.49)	(1,241.26)	(510.52)	40.19	(504.65)
Gilts	37,300.00	37,300.00	33,222.83	25,300.00	19,087.55	15,200.00
Dividend Income		270.85	253.39	223.19	204.84	193.27
Gilt Interest		2,797.50	2,332.50	1,897.50	1,500.00	1,140.00
	48,000.00	51,877.54	48,644.61	36,829.85	27,660.47	24,618.31
Units in Issue	48,000	48,000	38,000	29,600	22,500	16,500
Unit Price (p)	100.00	108.08	128.01	124.43	122.94	149.20
Maturity Proceeds		10,807.82	10,753.02	8,834.19	7,376.13	7,460.09
Bonus		1,707.82	2,553.02	1,534.19	976.13	1,960.09
Guarantee Cost		0.00	0.00	0.00	0.00	0.00
Bonus Percentage		18.77	31.13	21.02	15.25	35.64
Gilts Matured		6,200.00	5,800.00	5,300.00	4,800.00	4,300.00
Equities Sold		1,610.16	2,596.04	1,490.19	862.82	1,940.85
Reduction in CGT Base		1,327.40	1,680.41	1,183.41	896.68	1,484.75

only 15%. In retrospect we can see that this has resulted in a less than fair share being paid out on the policies that matured in year 2, and a corresponding increase in the subsequent unit price. If there had been no capital growth after year 2, on the other hand, it would have been seen in retrospect that too much had been paid out.

8.11 Table 8.5 shows the same portfolio as Table 8.3. As before, the assumption that the dividend will not reduce in year 2 has had a small effect on the bonus paid in that year, increasing it from 8.78% to 8.84%. The unit price in

Table 8.7

Highest and Lowest Unit Prices

Year	All Equity Portfolio		Matched Portfolio	
	Best	Worst	Best	Worst
1	130.40	87.40	118.73	98.05
2	143.42	97.17	128.01	106.25
3	159.81	105.59	141.57	113.47
4	176.91	116.28	153.20	122.94
5	181.34	121.51	159.43	133.63

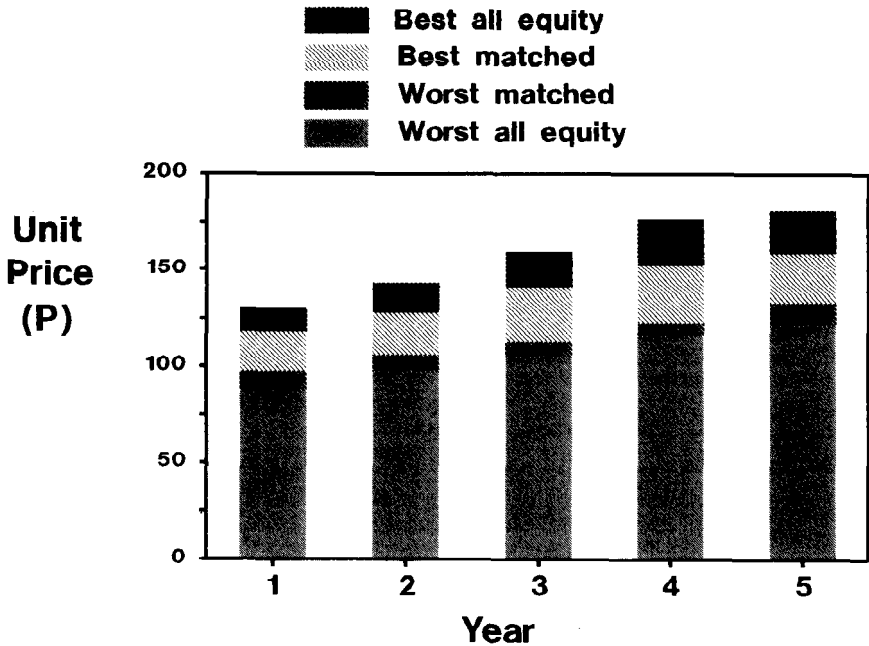


Figure 8.7.

year 5 is up from 148.40 to 149.50 again largely due to the effect of the 15% tax allowance in year 2.

8.12 Table 8.6 shows the alternative sequence of peak in year 2 followed by trough in year 4. In this case the unit value of 149.20 in year 5 is closer to the value of 148.40 in Table 8.3. The reason for this is that the tax credit in year 4 in Table 8.6 is smaller than that in year 2 in Table 8.5.

8.13 We conclude that the order of the fluctuations is not important, and that our simple model of 'normal' and 'critical' values is, if anything, conservative compared to the results obtained by modelling cyclic variations.

8.14 We have also run the projections with the peak and trough occurring in each of the other years. The best and worst results measured by the unit price are set out in Table 8.7, and are displayed graphically in Figure 8.7.

9. PRACTICAL APPLICATION

9.1 There is no difficulty in calculating the hypothetical paid-up values for the business in force and projecting the expected pattern of claims. We can then make projections based on the actual constitution of the portfolio and on possible restructured portfolios. It is necessary to bear in mind the over-

simplification that is involved in the model. For example, the assumption that transactions only take place at one time during the year. More importantly, we must bear in mind the fact that the policies will have been taken out at different times in the past and the units attributable to them will not be directly proportionate to their paid-up values. A total asset share greater than the total of the paid-up values payable may therefore conceal a number of policies under which the guarantee would be operative. As a rule of thumb we might look for a minimum average terminal bonus of 10% to be reasonably certain that some terminal bonus would be payable on each individual policy.

9.2 In practice we would aim for a higher minimum value on the grounds of policyholders' reasonable expectations. The nature of terminal bonuses is such that policyholders ought to expect them to be reduced in times of low stock market prices, but one cannot expect too much sophistication in this regard, and it is unlikely that the implicit gearing in the system is generally appreciated. We would therefore consider an average of 20% implying not less than 10% on any individual case to be the minimum that we should provide for on the basis of the model.

9.3 We must also recognise the fact that the model is not a worst case scenario. We believe that it is a reasonable basis for determining the long-term investment strategy of the fund. We have it in mind that traded stock options could be used to address the problem of risk in relation to maturities due within twelve months. If the exercise described indicates that a 25% drop in equity values over the next year would reduce the average terminal bonus to less than 20% we would look at those expected maturities more closely. We could schedule them by month of maturity and also by year of issue to see where the worst cases would occur. A modest expenditure on stock options should then enable us to protect the fund against the potential cost of guarantees. So far the actual results have been sufficiently far in excess of the guarantees for this not to be necessary.

9.4 In practice, the major constraint has been the fact that we wished to value the liabilities at $3\frac{1}{2}\%$ p.a. On the assumptions used in the above models a valuation rate in excess of 2% p.a. could not be used under the current valuation regulations. Switching part of the portfolio into fixed-interest stocks helps considerably with this problem, although it is not a good enough reason by itself to do so. In fact we have concluded that some fixed-interest content is desirable on general grounds and, as a rule of thumb, have specified that a minimum of 20% should be so invested.

10. CONCLUSIONS

10.1 We set out with the objective of describing a particular development that we believe is unique to our office, but which we think enables points of general interest to be considered. We did not expect to discover any new actuarial principles, and do not expect anyone to be surprised by the results from our models.

10.2 The model is simple, and we have not tried to extend it to a stochastic approach. We have simply said "look what happens to the policy proceeds if such-and-such happens to the stock market". Simple as this approach is, it has enabled us to draw some conclusions in this paper, and in a working environment to make decisions and give instructions to the investment managers. As with many exercises of this kind, we expect the value to come through the comparison of successive results, rather than from one particular set of figures.

10.3 It only remains for us to make the usual disclaimers as to the responsibility of anyone else for any opinions contained in this paper, and to thank Andy Fail for his work on the models and Lucinda Haig for typing numerous drafts.

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ABSTRACT OF THE DISCUSSION

Mr R. E. Lee (opening the discussion): This paper is timely, because there has been a growing trend in the market towards the concept of unitised with-profits, which bridges the gulf between unit-linked and conventional with-profits business. It is also valuable because, to the best of my knowledge, this is the first discussion of this topic at a sessional meeting and it goes to the heart of some of the actuarial problems surrounding investment strategy, matching and reserving.

The authors outline the development of unitised with-profits from the standpoint of a unit-linked office. However, the majority of offices that have developed unitised with-profits funds have been traditional with-profits offices.

In Sections 2 and 3 the authors outline the problem their office faced, of needing a wider range of products in the light of the 1974 stock market decline, and the unitised with-profits solution developed. Other companies have arrived there from different starting points. In the case of my own office, the main problem was enabling policyholders to switch freely between with-profits contracts and a recently introduced unit-linked range. In the case of some with-profits offices, the attraction of unitised with-profits was the slower build up in reserves compared to conventional with-profits, especially during a period of rapid business growth. It also brought greater flexibility and appeared to be a little easier to understand than conventional business. For others it was the advent of personal pensions, the need to provide a return of fund on death, and a growing acceptability of the unit-linked concept. It is, therefore, not surprising that so far most unitised with-profits funds have been established for pensions contracts. There are, however, a growing number of companies transacting life business on this basis, but the practice often differs from pensions, no doubt partly because of the constraints on switching imposed by the current rules for qualification.

The technical structure described in Section 4 is very interesting. Essentially this covers a unit-linked contract with a guaranteed maturity value (equal to the premiums accumulated at $3\frac{1}{2}\%$). The contract is unit-linked because, throughout the term, the surrender values are based on the lower of the offer and the claim prices. The offer price is based on the market value, and the claim price is a smoothed offer price. The value of the contract is, therefore, closely related to the value of the underlying assets. The contract is 'participating' only at maturity (or on death), by way of a terminal bonus and calculating the bonus is a relatively simple exercise of taking the difference between the market value, represented by the offer price, and the guaranteed maturity value.

These features appear to differentiate the authors' contract from most other unitised with-profits funds, which are more closely related to conventional business. These have annual bonus declarations and the associated problem of distributing surplus. The surrender values bear closer relation to the premiums plus accumulated bonuses than to the market value of assets, and are therefore much more smoothed. However, in exceptional circumstances, for example the 1987 crash, most companies make some adjustment to the surrender or switch values to reflect the market values and protect the remaining policyholders.

Whilst a 4% guaranteed bonus rate is found on two-thirds of unitised with-profits pensions contracts, such a guarantee is less common on life contracts. When there is a guarantee, it is normally 3%, so the contract described in the paper with a guaranteed rate of $3\frac{1}{2}\%$ in the life fund is high by market standards. The reserving requirements are, therefore, more onerous. The reserve will normally be greater than the market value of assets because of the need to reserve for the guaranteed maturity value. On the other hand, for offices granting no underlying guarantee of bonus, the reserve is normally just the premiums with accumulated bonuses to date, together, perhaps, with an expense reserve determined in the same way as the non-unit reserves for linked business.

The $\frac{1}{2}\%$ p.a. paid to the proprietors, being a fixed percentage of the fund each year, differs from the rest of the proprietary offices, where a percentage of the bonus is the norm. Whether it is a percentage of fund or of bonus, the profit flow to the shareholders from unitised with-profits business in a proprietary office is worthy of comment. The profit flow is similar in shape to the profit signature from a conventional with-profits contract: it grows steadily over the term, but it is likely to start from a much lower level and build up more slowly in the early years, especially if a front end charge is imposed. However, it is very different from the unit-linked profit signature where a large proportion

of the profit normally emerges in the first two years, probably after some initial strains, and then the remainder emerges steadily over the rest of the term, but at lower levels than on a conventional with-profits contract. For those companies which allow switching between unit-linked and unitised with-profits, the position is quite interesting. A switch in year 3 from unit-linked to with-profits means the proprietors get the front end profit from the unit-linked and the back end profit from the with-profits contract. However, a switch in year 3 from with-profits to unit-linked will result in very little overall profit emerging.

In §§ 5.8 to 5.10 the authors describe their treatment of joint life assurances with the sum assured payable on second death. They rightly point out the potential problems at the review after the first death on a high sum assured contract. However, there is another potentially more serious problem with this approach. Whilst there is an incentive for the remaining policyholders to notify the company on first death, I doubt this will be understood by the vast majority. The resulting danger is that the risk is actually much larger than anticipated and there may not be sufficient reserves to cover it. I prefer the approach of using mortality rates which reflect the probability of both lives or just one life being alive throughout, because then there is no need to worry about notification of first deaths.

In Section 6 reference is made to future developments. I see no benefit in developing a fund with a reversionary bonus. My view is that, in terms of the product life cycle, the future of reversionary bonuses is approaching the end, and it would be interesting to debate the motion that 'With the advent of unitised with-profits, reversionary bonus contracts are an anachronism'. I think the higher level of reserves required against ever increasing demands for capital, together with the need to be compatible with unit-linked business, will hasten the transition to unitised with-profits. I can, however, see merit in adding an accumulation or annual cash bonus related to the size of the fund, and, indeed, this is almost universal amongst unitised with-profits funds.

In Section 7, on investment strategy, I can see why, given their unit-linked background, the authors started from a strategy of equity investment 'unless there is a demonstrable need to hold fixed interest', but would question whether it is appropriate. I have called the authors' contract a unit-linked contract with a maturity guarantee. Their main concern is the guaranteed return of $3\frac{1}{2}\%$, that is 4% allowing for the proprietor's share, but, at the outset, this is well in excess of the guarantee on most conventional with-profits life contracts, where the guaranteed sum assured is approximately the sum of the premiums, representing a 0% guarantee. Admittedly, there is no running bonus on top of the guaranteed return. However, the company is principally unit-linked, and, therefore, presumably does not have significant free reserves, and the level of guarantee is not far short of that associated with a non-profit contract. I am, therefore, nervous about the implications of the investment philosophy.

For most unitised with-profits, the guaranteed liabilities are building up as each bonus is declared. This should, in theory at least, require a growing proportion of fixed-interest investment as the maturity date approaches, if assets and liabilities are to be matched. The size of these guaranteed liabilities will become very substantial as time goes by, and the requirement to satisfy the resilience test will require significant mismatching reserves if fixed interest stocks are not used to match the guaranteed liabilities. There will come a time when it will no longer be sufficient to use the existence of market value adjusters as an excuse for not having mismatching reserves and a departure from fixed-interest investment will only be possible if sufficient free reserves are available.

I think, therefore, that the methods developed in Section 8 to check the sufficiency of the reserves against various investment scenarios are very useful to the particular situation described in the paper, but doubt whether they can be applied more widely to unitised with-profits funds in general. It would, however, be interesting to know if the authors investigated the cost of their guarantee on the basis suggested in the Maturity Guarantees Working Party's report, or, indeed, whether they have tested the harsher resilience parameters of a 5% rise in gilt yields and a 40% fall in equity prices, suggested at the Birmingham Convention in 1985.

Unitised with-profits is a very important topic. The profession has spent much time in recent years on conventional with-profits considering bonus philosophy, and on unit-linked considering pricing and valuation, but very little on unitised with-profits, which falls somewhere between the two. It is becoming an increasingly important component in life and individual pensions business. The ABI now provides information on the amount of unitised with-profits business in the individual pension

schemes market. In 1988, the share of unitised with-profits business measured by premiums receivable was 10%. In the first three quarters of 1989 it had risen to 15%. Given that 46% of this market is unit-linked, that leaves 39% as conventional with-profits, and means that unitised with-profits now represents over a quarter of all with-profits business in this market.

Mr D. E. Purchase: In § 2.4, the authors comment on the design of modern unit-linked whole life contracts. I share their concern about the possible consequences when policyholders reach advanced ages. If the value of the unit fund is comparable to the sum assured, the contract can be highly unstable. It is little consolation that the conventional form of non-profit whole life policy has equivalent, though not identical, disadvantages if premiums remain payable throughout life. In § 3.7 the authors refer to an exponential smoothing process. I should be interested to learn whether there is a rapid decay, so that the effect of very recent price history dominates, or whether the effective period of averaging is quite long. Also in § 3.7 the terminal bonus formula is described as if it is fixed, and I wonder how much discretion there actually is with regard to the size of the bonus payment. In § 5.5 the authors describe the way in which the reserves are calculated under variable sum assured contracts when higher than standard life cover is selected. I believe this method is quite often used for modern unit-linked whole life plans. While in normal circumstances it seems a satisfactory approach, I am by no means certain that it is adequate for the 'worst case' exercise of option, as required by Regulation 62, because, in my view, the protection given by any right to vary the mortality charges is not complete.

In § 8.3 the authors quote a resilience test of -25% for equities, +3% on the gilt yield and a 10% drop in dividend income. While this last has much merit, a fall in dividend payments is not actually part of the GAD standard benchmark test.

The paper describes an approach to participation which is unlike almost anything else in the United Kingdom market. At the time it was introduced it seems to have had little effect on the rest of that market, but in the last five years or so, as the opener has told us, we have seen a rapid expansion in the number of with-profits funds available. Pressures on conventional bonus systems have shown no sign of easing. We continue to see the ratchet effect operating, and current maturity values do not look supportable for new business on reasonable long-term assumptions. It has been argued that it was the change from mortality expense to investment earnings as the main source of surplus, and, in particular, the change from income to capital growth as the prime contributor to investment return, that has made the traditional bonus system less suitable. My own view is that it is the volatility, rather than the source, of surplus that will ultimately lead to new systems becoming the norm. A with-profits fund distributes surplus in proportion to the reserves held, which, at least conceptually, is more suited to dealing with varying investment returns. The authors refer in § 6.2 to the possibility of distribution of other sources of surplus under their contract, and I would expect these to be available under a with-profits fund. Currently, their amount is such that a bonus in proportion to reserves is still appropriate, but the concept has enough flexibility to handle alternatives when these become more equitable.

The approach to reserving for this type of business is an issue worthy of much more attention from the profession. Here the approach used by the authors will prove to be worth investigating in the wider context. Much with-profits fund business is written with an interest guarantee. This may be an unfortunate development—and I suspect that the authors' 3½% in the net fund is somewhat high—but even in the context of a guarantee of 0%—in other words, that the unit price will not fall—the reserves need to be carefully considered. With-profits fund business is, or is akin to, a single premium business, and I know that the authorities are concerned that, without the discipline of the net premium valuation, profits could be released prematurely by the use of too high a valuation rate of interest. In practice this is unlikely to occur, but that does not necessarily reassure others. There is, however, the protection that under most with-profits fund contracts the surrender value is normally equal to the full value of units, so the current regulations provide some protection. If investment conditions are such that the surrender values are reduced below the nominal value of the units, then it seems reasonable that reserves may also be lower. At the current stage of development of most offices' portfolios of with-profits fund business, the protection of the surrender value adjustment makes a formal mismatching reserve unnecessary; but that will not remain so as the business matures, and

then I shall find the approach in Section 8 of the paper most helpful. The comments on investment philosophy will also be of interest for mature with-profits fund portfolios, although for these there is more freedom than with the authors' specific contracts.

I have commented, and so did the opener, on the need for more work within the profession on with-profits funds. As a starting point, the Life Assurance Joint Committee recently concluded that (as suggested at the Harrogate Convention last September) a survey of current practice should be undertaken. A small joint working party has been set up. As chairman, I hope that the results will help to point the way forward.

With-profits business is currently in a state of flux. I cannot predict whether it will evolve into something based on the with-profits fund concept, or something yet to be developed, but I doubt that it will remain as hitherto. In this changing scene, the authors' paper, tackling the problem from the other end, as it were, has been most timely and valuable. When I read the solution in § 3.3 to their particular problem—that is to say, the elimination of the bonus loading—I was immediately reminded of the world envisaged by Frank Redington in 'The Flock and the Sheep and other essays' (*J.I.A.* 108, 361), where all with-profits premiums were at 110% of their non-profit equivalent. Perhaps that world is not as imaginary as he assumed.

Mr P. D. Needleman: The authors have described in detail the mechanics and philosophy underlying a particular approach to with-profits business originally adopted by a specialist unit-linked office some 15 years ago. The marketing need identified by this office was for a contract offering stability and guarantees—whilst still providing the potential profits from equity investments. In other words, they required some form of with-profits contract. They concluded that they were unlikely to be able to compete in the conventional with-profits market, and the solution adopted was a type of hybrid contract offering a basic guaranteed sum assured together with investment surplus allocated by way of terminal bonus, which closely reflects the asset shares under the contract.

The technical structure of the contract may have been innovative, but it seems to lack some flexibility in so far as the investment component is driven by the reserving basis. For example, the ability to front-end premium margins is limited to the maximum Zillmer adjustment permitted by the regulations and additional reserves may be required in respect of renewal expenses, if the margin between the net premium and office premium is insufficient. It would be better, in my opinion, to determine an efficient charging structure as for a unit-linked contract and hence the investment component. The guaranteed sum assured is the investment component accumulated at the guaranteed interest rate. This is the approach which I think is described in § 5.12 for pension contracts, and is similar to many modern unitised with-profits contracts.

Where the structure has been adapted to provide greater flexibility—for example, for variable whole life contracts—then some of the simplicity of the basic approach is lost. Also, the technical problem described in § 2.3 is not resolved by this contract, that is, a negative unit component will always be required at higher ages for a whole life contract, although this may not be obvious to the policyholder. Again, in my opinion, the modern solution is preferable, and here I would disagree with Mr Purchase, since the policyholder can see exactly what his life cover is costing him. Even if this is more than his current premium, the policyholder can always choose, if he wishes, to reduce the level of life cover. One particularly attractive feature of the approach described in the paper is the use of a unit price to track the asset shares for each contract. Given that unit-linked systems already exist, this is the easiest method of deriving asset shares and is an approach which is increasingly being adopted by offices operating unitised with-profits funds.

In considering the underlying nature of the contract, the first question is whether this contract can be considered to be truly with-profits. I suggest there are four basic features which characterise a with-profits contract as we currently understand it: a basic level of guaranteed benefits, which is usually increased (by the addition of bonuses) throughout the duration of the contract; a pooling of investment risk and an element of smoothing of performance; distribution of investment profits is discretionary, that is, there is no direct link to the performance of a pool of assets; and there is usually a significant degree of equity investment. Some might add a fifth requirement, namely, a sharing in the various miscellaneous sources of profits, but I do not consider this to be essential.

The approach described provides a fairly high initial level of guaranteed benefit compared to a

conventional with-profits contract, but is unusual in that the guarantees are not further increased by the addition of reversionary bonuses. The authors state that this would be possible, but I believe that it would require a much lower level of initial guarantee and would be likely to constrain investment freedom severely. With the current approach, a high proportion of the ultimate benefits are likely to be provided by terminal bonus, and it is this feature which allows the office to invest a high proportion in equities without the need for a significant level of capital to support mismatch reserves.

The other important feature is the way in which the cost of any maturity guarantees is met by the continuing policyholders and directly reduces their 'asset shares'. For conventional with-profits, it might be considered appropriate for the estate to be used to meet any such guarantees, without any direct impact on the ultimate payout to later generations of policyholders. The approach adopted is another essential feature for unit-linked offices introducing a contract with guarantees. If the risk is borne by the office rather than by policyholders, not only will the cost need to be considered carefully and charged for adequately, which may make the contract appear uncompetitive, but the reserving requirements will be more severe and the capital needs correspondingly greater.

It is stated that the terminal bonus is based on a smoothed unit price, however it is not clear to what extent smoothing takes place. From the description provided, it appears that only very limited smoothing is carried out, and the terminal bonus fluctuates closely with the underlying value of the investment fund. It is in this sense that the contract is closest to a unit-linked managed fund contract (albeit with an underlying investment guarantee). It would be interesting to see a comparison of payout on this contract compared to a typical with-profits contract, and also a unit-linked contract invested in a managed fund over the same period.

The question of matching and investment strategy is discussed at length. Two problems are identified which are very much inter-related. The most important point is that there must be a significant margin between the expected long-term yield and the guaranteed rate—not only to ensure that the guarantee is not too costly, but also to ensure that the level of terminal bonus is substantial. The latter is essential if a high equity backing ratio is required, so as to provide a buffer against a sudden fall in the market value of the fund. A margin of, say, 4% net of tax would result in a terminal bonus of about 10% after five years; 20% after 10 years; and increasing to 50% after 20 years. The problem is that the average duration of many with-profits funds is relatively short—probably about five years—so the use of the terminal bonus to provide working capital in this way is relatively limited.

The examples provided in Tables 8.1 to 8.6 show that, in certain circumstances, a relatively high proportion of fixed-interest investments is required if the guarantees are not to be called on. The long-term impact on the unit price appears to be fairly small, but I suspect that this would be much greater if a more realistic margin of, say 2% to 3%, between equity returns and gilt yields, was assumed, and also if some allowance was made for indexation of capital gains. The examples do not appear to include any smoothing of the unit prices in calculating the 'critical values'. If a significant level of smoothing were applied in practice, then a substantial fall in values might not immediately result in the smoothed price falling below the guaranteed value.

Mr N. J. Dumbreck: This paper raises some interesting questions about the capital needed to finance the writing of with-profits business. It is of particular significance to the new offices which have recently been launched or are about to be launched and which expect to obtain most of their business from banks, building societies or estate agents. At least one such company offers a with-profits product, but I understand that it is wholly reinsured, and that does not seem to be an ideal arrangement for the longer term. What are the alternatives for such companies? The conventional reversionary bonus product is not one of them. It is exceptionally capital intensive in the early years, mainly because of the high cost of reserving for declared bonuses. In an established company, the mature business can provide much of the financing that is needed, to the extent that surplus is held back for declaration as terminal rather than reversionary bonus, but the cost to a new company of getting to that mature position is huge, and this acts as an almost insurmountable barrier to entry.

The paper describes one possible way in which a company without vast capital resources can enter the with-profits market. Unitised with-profits business of the type which many of the larger offices are now writing may provide another. The product described in the paper offers a guaranteed sum assured which remains unchanged throughout the life of the contract. There is no 'on account'

distribution of surplus corresponding to reversionary bonuses. This enables a relatively unconstrained investment policy to be pursued, but does mean that policyholders are given very little indication of the progress of their policies during the term of the contract, which is perhaps a disadvantage in these times of full and frank disclosure. The unitised product, on the other hand, involves an increasing guarantee as bonus interest is declared. This may reduce investment freedom, but could make the product more suitable for some purposes, such as mortgage repayment. Having said that, §6.1 of the paper does indicate that a reversionary bonus could be incorporated in the authors' product without undue difficulty, and review procedures can be introduced to home in on a target maturity value.

One possible problem with the product described in the paper is that it is inextricably tied to the net level premium valuation method. This means that mismatching reserves are likely to be needed, and increases the cost of getting started. It also means that the office is potentially exposed to a severe fall in asset values, particularly while the portfolio is developing. Any office going into this business would need to consider how it would fare if equities were to fall in value by, say, 50%.

There seems to be a significant advantage these days in treating contracts as recurring single premium policies for valuation purposes, and this is where the more typical unitised with-profits policies may have a slight edge. Single premium reserves are much more sensitive to a change in the valuation interest rate than are net level premium reserves, and mismatching reserves are, therefore, less of a problem. So far as I am aware—and this has been confirmed by Mr Purchase—most unitised with-profits business is written on a recurring single premium basis.

Nevertheless, the product which the paper describes has many attractions, if only because several of the aspects which appear to cause difficulty for the more typical unitised with-profits business—such as terminal bonuses and surrender values—fall out naturally from the way the business is operated. The paper confirms that it is possible for new players to enter the with-profits market by getting away from the conventional reversionary bonus approach. I am not sure that I would have thought that this product would have gone down well with the company's sales force when it was first introduced, but it clearly has been a success.

Mr R. E. Brimblecombe: The paper indicates that the thrust for unitised with-profits business came from the need for unit-linked offices to satisfy their direct sales forces, following the stock market crash in 1973–74. My own office, a traditional with-profits one, was fairly late in the field of introducing a unitised with-profits policy for a number of reasons. From a market point of view, the last few years have seen a greater demand for transparency in contracts, particularly in the run-up to the Financial Services Act. There has been pressure on offices to try and issue an investment-linked contract, which was not unit-linked, but which made more sense to the policyholder. However, if that was the reason why they were introduced in the first place, why did offices produce what was rather a complicated contract by using unit pricing rather than, perhaps, a traditional deposit administration type of contract with bonuses relating to the excess earnings on the fund each year over a minimum of, say, 3%, 3½% or 4%?

The second reason for introducing unitised with-profits policies was the almost impossibility of allowing a switching facility between with-profits and unit-linked products, particularly over the last few years, where individual pension policies, especially those for the self-employed, needed this type of facility for marketing reasons. My office markets unit-linked products on a risk/reward related basis, and we examined the products to see where a unitised with-profits policy would appear in looking at likely risk related signatures when compared with our unit-linked funds. We were able to demonstrate that, over a long period of time, the likely return to policyholders appeared to be far more stable than for any of our unit-linked funds, as the estimated range of returns was far less extreme than any of those funds. Therefore, from a marketing point of view, our unitised with-profits pension contract could be seen, not just as a safe haven for money as an individual approached the maturity of his policy, or pension age under a pension contract, but as an integral part of an individual's risk-related investment strategy throughout the term. Unlike most offices, the guaranteed return on our policy is not fixed in relation to an interest rate (for example, 3% or 3½%), but is related to the return on a stated gilt, thus making the contract nearer a unit-linked contract than those described in the paper. The approach where the return is not related to a fixed rate of interest

removes at least one of the problems that Mr Purchase has indicated: the funding of fixed-interest-rate guarantees.

Unitised with-profits policies are, in my view, with-profits business, and I believe that the policyholders should meet guarantees and the shareholders should receive only their normal percentage of the excess investment returns which are declared by way of bonuses. One of the problems for the actuary of a mature life office, however, is that, because they are with-profits and form part of the same funds as the orthodox life and/or pensions contracts, the question of equity in declaring bonuses becomes paramount in his mind. This is increasingly a problem when looking at the complicated pattern of normal reversionary bonuses, special reversionary bonuses and terminal bonuses which are now being declared. Nevertheless, if the problem can be solved by looking very carefully at the asset shares for orthodox business, like is being compared with like. Whilst with-profits premiums may not, long term, support current bonuses, I believe that offices are not over-distributing when compared with asset shares, except possibly for short-term policies.

The opener referred to the fact that the ABI figures showed that the market share of unitised with-profits policies is increasing. I am not entirely satisfied that the statistics provided do produce a true reflection of how the market has moved, and the ABI is looking at ways of improving the market information in this area. Even allowing for that, however, it is fair to say that, in the last nine to twelve months, the figures have been distorted by the huge market in personal pensions, and it is the experience of my office that over 75% of personal pensions business is on a unitised with-profits basis, particularly for those who are taking minimum contracted-out schemes; and that, coupled with the much lower activity in the house purchase market, is reflected in the figures that have been published.

Looking to the future, clearly there is always a market for new policies. However, I think that unitised with-profits policies *per se* will, in future, possibly be used only by new offices or existing unit-linked offices because of the capital otherwise required to finance new business strain for orthodox with-profits business, and perhaps they will be encouraged to move their guarantees nearer the 0% already mentioned. There will continue to be a large market for orthodox business in the mortgage endowment market for mature offices, but unitised with-profits policies will certainly be used, particularly under pensions policies where switching facilities are needed with the unit-linked fund.

Mr T. W. Hewitson, F.F.A.: The new unitised products are generally written on single premium terms, and offer annual bonuses with a relatively limited terminal bonus. The investment and reserving problems are, in principle, very similar to those of unitised policies described in the paper. These unitised with-profits policies will often be sold on the basis that the investment content of the premiums will be largely invested in equities. If a sizeable portion of the annual investment return, including capital gains, is then distributed as an annual bonus, the matching considerations become very similar to those described in Section 8. It is then necessary to consider whether the assets would be adequate to cover the guaranteed liabilities on a variety of possible investment scenarios. This will help to demonstrate the point when assets should sensibly be switched out of equities into fixed-interest securities, and also the size of any mismatching reserves that may need to be set up.

Unlike Mr Purchase, I am not entirely convinced that it is sufficient to have regard to a potential surrender value adjustment factor. If the discount rate implied by this surrender value adjustment were too high, then it might not be feasible to readjust the asset portfolio to provide the required level of investment return. In any event, it is questionable as to what extent the reserving basis should reasonably have regard to future asset switching, bearing in mind, for instance, the speed at which markets fell in October 1987. In §8.3, an appropriate set of assumptions is set out for this dual purpose of looking at reserves and also the asset composition. This includes a suggested fall of 10% in the dividend income, although I do not believe that such a parameter has even been formally suggested by GAD. Conversely, however, no account is taken of a possible fall in the yield on gilts or fixed-interest securities, although this scenario surely cannot be ruled out altogether. Of course, an office would probably wish to examine the development of the fund on a number of different assumptions, possibly even including a stochastic model, as mentioned in Section 10.

A small working party has been set up to collate the results of a recent survey of practice in the subject of unitised with-profits policies and to identify fields for further research. These may well include some of the points covered in the paper, including such issues as the development of an estate

for this business; the level of smoothing of bonuses that is deemed appropriate; the relative effect of different investment scenarios on each generation of policyholder; and the comparative interests and expectations of policyholders with these unitised policies relative to conventional policyholders and shareholders. For example, under the newer type of policies, bonuses may be distributed to these policies regularly during the year by way of an increase in unit price, but the main distribution of surplus to other with-profits policyholders and shareholders occurs only annually.

Mr J. T. Gould: The authors began by saying that the unitised with-profits concept was developed as a solution to a marketing problem. Various speakers have contrasted how the technical structure varies from what traditional offices moving into this area have done in the last few years. The opener gave some fairly comprehensive reasons as to why a traditional office might adopt unitised with-profits, particularly the lower new business strain and the easier understanding from the policyholder's point of view. A unit-linked office looking at this marketing problem now, which is still just as relevant, would probably come to a different solution. In the last year or two we have seen many portfolio insurance-type products emerging, generally with fixed terms of one to three years. These have taken advantage of the more modern investment instruments such as futures. It seems to me that unit-linked offices are more likely to be looking at a solution along these lines, rather than a technical actuarial one, which would involve reserving for guarantees, heavier capital requirements and so on.

Mr H. H. Scurfield: Mr Brimblecome mentioned some of the reasons why traditional life offices were moving into unitised with-profits policies. Here are two other reasons. First, a pensions product policy often has variable premiums which come from different sources. The unitised with-profits type of policy can cope better than the regular annual premium policy. Then, some offices have the same bonus rate for annual and single premium policies. There is an inequity in this approach which unitised with-profits policies overcome.

I was concerned when someone said that the guarantee might be provided by the estate and, therefore, not charged back to the policyholder. Considering the past 15 years, we have, perhaps, grown almost complacent that large positive returns will continue. In practice we know they will not. There is a very real cost to the guarantee which we are providing, and it would be wrong for any generation of policyholders to expect to get that guarantee for free. I wonder whether the $\frac{1}{2}\%$ referred to in § 3.8 is in fact the correct amount. It does, of course, depend very much on the investment policy that goes with it. The authors begin with wanting to have 100% of the money invested in equities, but they are moved back from that. The extent to which you have to move into fixed-interest investments depends, among other things, on the free reserves or the estate of the office. If we look at annual premium contracts over any period of time since the War and compare the amount of money that would be accumulated by different investment scenarios, the money invested in ordinary shares invariably produces much the greater accumulation (or maturity money); property usually the second; and fixed interest the least.

A recurrent single premium policy requires less financing than an annual premium one, with the regulations as they are, but is it logical? To the insured the contracts are the same, but if we regard the policy as one thing it requires more financing, and if we regard it as something else it requires less financing. This is an area which needs some research.

Smoothing was referred to in § 3.7. People opting for with-profits contracts assume that these will be much more stable than unit-linked policies. Mr Brimblecome said that the unitised with-profits policy produced a more stable return, but it does not do so automatically, it depends on the extent to which you have deliberately smoothed it. If you do not smooth, it will produce the same sort of return as would a mixed fund portfolio. This is important, because policyholders have come to expect the with-profits policy to provide smoothing and not to go through the gyrations that the stock market went through in October of 1987 and 1989.

Will mortgage endowments become unitised? A suggestion was made earlier that they will not. A form of unitised contract, not necessarily the one described in the paper, will become increasingly popular, and I see no reason why it should not apply to mortgages. There would need to be a certain amount of education; but, ultimately, as people get more used to unit-linking or to investing in shares,

I believe that unitised with-profits is something which they will find easier to understand than the traditional with-profits.

Mr H. D. White: When choosing the investment policy backing unitised with-profits products, the authors invested considerable amounts of money in gilt-edged securities as protection against poor market performance. I would not take this approach. Where I do agree with the authors is in § 7.3, when they pointed out that the income from an equity portfolio is significantly more stable than its market value. This is a good starting point. Considering the income from fixed-interest investments for a long-term whole life or pensions policy, this too can be rather unsatisfactory, and perhaps not as good as that offered by equities. There will inevitably be a reinvestment problem of the proceeds of the gilt-edged investments over the term of such a long policy. It is thus important not to manage the capital value of the fund, but rather the investment income that is backing the guarantees, so this will pay off the liabilities in the long term.

The authors suggest, in § 8.8, that there might be a massive switch to fixed-interest investments in the event of an unfavourable equity performance. This could be a disastrous policy. I have considered the question using alternative stochastic simulation models, and equity performance can fall far more than the dividend income growth, as the authors have pointed out. If there is a severe fall in prices, this may be temporary, and a switch into gilts will only serve to establish the loss permanently and make the fund under-perform. It is probably a far cheaper policy to begin by investing a small but significant proportion of the moneys in fixed-interest investments, rather more than the 20% suggested in § 9.4.

I do not think that the authors looked at the worst case when considering adverse investment scenarios. From the point of view of what investment income is being generated to back the liabilities, the worst scenario might be first a fall in equity dividends and prices, followed by a significant fall in fixed-interest returns and then a gradual increase. So, if the market is performing rather badly in a period of deflation, we might find that we are returning to a position more akin to the 1920s or 1930s. In this case, the fund would first switch to holding a higher fixed-interest asset proportion and might still maintain solvency, but if the low interest rates in the world economy actually help the recovery of the economy and generate a gradual and slow rise in interest rates, there will be a steady depreciation of the fixed-interest assets, which will, to some extent, offset the income which these assets are generating. Over a period of time, genuine insolvency will occur. The solution is, perhaps, in the first place, to invest a significant proportion of the portfolio in high yielding fixed-interest securities, then, if equities depreciate and interest rates fall, which is the real danger, there is capital appreciation to maintain the office and the product in a position where it is quite solvent and sound.

Professor A. D. Wilkie: Paragraph 3.6 refers to the amount that should be charged for providing a guarantee from one generation to the next. I have outlined some thoughts on this subject in a previous paper (*J.I.A.* 114, 21) and my approach to it was that modern option pricing methodology should be used as a way of calculating how much the charge should be. This is quite different from the point given in § 9.3 of actually using traded share options as part of the investment in the portfolio. What I wish to consider is a very simple single premium policy where some amount of premium has been paid and the policyholder is going to get the accumulated value of the units or the guaranteed sum assured, whichever is the greater. In effect, he owns the units with a put option to sell them back to the office at the guaranteed price. If he has an annual premium contract, he builds up the guarantee bit by bit with each annual or monthly premium, as the case may be; and there are alternative ways in which he could be building up his guarantee, and alternative ways in which the put option premium could be taken from the chargeable office premium from month to month. If he reaches the maturity date or he dies at an earlier stage and the unit value is less than the guaranteed amount, then he, or his executors if he is dead, exercises the put option on whoever has provided it and takes the guaranteed amount.

Option pricing methodology gives one a way of deciding how much the charge for the put option should be. It depends on the volatility of the investment medium, the shares, or whatever the units are invested in; on the term to go; on the relative amount of the guarantee; on current interest rates; and so on.

I am not sure, in the authors' case, whether there are not two different sorts of put options. One is the contractual one, whereby there is a guarantee that the smoothed value of the units can be put in exchange for the guaranteed sum assured, which will, one hopes, seldom need to be exercised; and there is the other one, whereby the current market unit value is exchanged for the smoothed unit value. This, again, seems a type of put option which is operating in both directions. There may be a put and a call simultaneously so as to shift from the market price to the smoothed price.

Who is providing the guarantee? If it is the shareholders, then the put option premium can be paid to the shareholders. They have to keep suitable reserves somewhere to provide the guarantee, and they provide the money as the guarantee is called. However, where it is with-profits policyholders, whether in the conventional or the unitised with-profits business, the guarantee seems to be provided from one generation to the next. The concept of the estate, which is passed on from one generation to the next, seems, possibly, the right way of doing this. A guarantee fund could formally be set up, which takes in the put premiums, the option premiums, for policies in force all the way along. Every time a policy expires by maturity, surrender or earlier death, then, either a guarantee is paid, which comes out of the estate, or the accumulated premiums within the estate for that particular policy are released to form part of the profit that is then distributable to the surviving with-profits policyholders. That could be calculated in a formal, precise way. There are problems of using this technique: about what basis to use for the put option premiums; what volatility to use; what rate of interest to use; and whether it should be gross or net.

Mr J. M. Souness, F.F.A.: Recently the Faculty discussed a paper by R. H. Ranson and C. P. Headdon (*J.I.A.* 116, 301), which told us all—and the Faculty with-profits companies had to be told—that there was no such thing as an estate! This paper describes something even further away than that. Paragraph 3.5 states that the next generation of policyholders pays for the benefits. This is a long way from where we thought we were in traditional with-profits. What we must now do, I take it, is to empty those large boxes of investment reserves, or any other so-called free reserves which we thought we had, and start again. However, of course, we will not do so. What we will have to do is to ask ourselves if we need to do anything at all other than, basically, what we are doing, and if what we have heard described is really different from what we have been doing.

I believed in transparency of product and six months ago based a paper on the subject. Listening and reading now, I begin to wonder whether we will have to go to the consumer and ask him if this is any more transparent than what he used to get. I know the reason for change is marketing and the switching requirement, but have we really changed anything? Have we simply provided a new system, or the mechanics for some form of switching? The opener thinks we have changed enormously, and said that the end of the reversionary bonus is in sight and that new business should all be unitised with-profits. I began to wonder whether it was not the same thing, anyway. Certainly, there will be similar benefits on maturity, but what will the surrender value be?

Mr Purchase said that volatility of investment return is not consistent with traditional with-profits, therefore you declare your bonus on reserves and not the sum assured, but there is no reason why the maturity benefit should not be the same. Once again, what is the surrender value? If you read the papers recently written on the subject, you will find that surrender value is not what we used to have, but is that value of the fund reduced by a market adjustment. That is so different to what it used to be, except that the number probably looks the same! What we have to do now is to start to focus some thinking on what surrender values are and should be, and hence, regrettably, how any investment policy would need to be modified.

Mr C. E. Barton: The authors, quoted in § 1.2, some extracts from a paper that I gave to the Students' Society 25 years ago (*J.I.A.S.S.* 17, 504). There are three separate extracts, the last being part of the conclusion. There are other parts of the paper I would have preferred to have been quoted, since this part of the conclusion was written with a little less conviction than the rest of the paper, because, at that time, I did not want to appear to be too brazen. However, I was concerned then, as I have been ever since, to get a more rigorous approach, and to get away from the arbitrariness of the traditional with-profits system.

It has been said that this is the first time a paper of this type has been presented to a sessional meeting. Of course, there have been many papers on with-profits business, but there was a paper on this approach, although different in content, 20 years ago by G. L. Melville (*J.I.A.* 96, 311). At the discussion on that paper and at other times I have said that it is all right to average between policyholders at any one point of time, but not to attempt to average between generations. Therefore, I am somewhat uneasy about the statement in § 3.6 that "Effectively each generation is providing a guarantee to previous generations, and benefiting from a guarantee by succeeding generations. . .". The early policyholders, when this business started in the authors' office in 1974 or so, could not have been providing a guarantee to previous generations, and I do not know how they could be benefiting from a guarantee from policyholders who were yet to appear and start paying premiums. The averaging should be between policyholders at one point of time. We should not mix up yesterday's claimants with today's policyholders, and still less with tomorrow's. It may be that the authors had in mind short-duration policies on the one hand and long-duration ones on the other. If that is so, that is perfectly all right, but that requires some system of transferring appropriate amounts from those who are being provided with a guarantee to those who are providing it. A system is required whereby assets are allocated in such a way that certain policyholders have allocated to them relatively more fixed interest assets, and others have less.

On the charge for the guarantee, Mr Scurfield referred to the $\frac{1}{2}\%$ margin which, under the authors' solution (§ 3.8), is taken in the rate of interest and said he assumed that was required for the guarantee; but as I understand it, this $\frac{1}{2}\%$ goes to the shareholders, whereas the guarantee is borne by the with-profits policyholders generally.

Mr R. E. Snelson: The basis of participation of with-profits policyholders, the statutory valuation basis and the guarantees given to the policyholders are inextricably linked. There are at least three separate situations for the rights of participation of with-profits policyholders. For many of the larger proprietary offices, their rights relative to the shareholders will be defined fairly rigidly in the articles of association, 'fairly rigidly', because I am sure that there are many arguments that arise about how these rights should be interpreted, particularly between different classes and generations of policyholders. Then there are mutual offices, where the actuary knows that, once he has determined the surplus, it does at least belong to the policyholders. Then there are some smaller proprietary offices, which appear not to have the rights of participation defined in their articles of association, where the policyholder is dependent on the promises in the sales literature and the definitions in the policy to define his rights.

Against that background we consider the problem of guarantees. Figures of 3% and 4% have been mentioned. With a guarantee of 3% gross, or lower, it is possible that the capital requirements, as dictated by the valuation basis, are relatively minimal. Some contracts in the market have a relatively low level of guarantee and relatively little strain. The attraction of these products from the policyholder's point of view is that it enables the office to invest heavily in equities and property, and if the investments perform well then the contracts will sell well because of demonstrably good past performance.

Considering the larger proprietary offices where, perhaps for the sake of illustration, the shareholders' participation is 10% of the surplus, the combination of this with a low level of guarantees can have the effect of giving the shareholders an unreasonable proportion of the fund. For example, if the bonus declaration is equivalent to a 15% yield and there is no guarantee, then the shareholders will have $1\frac{1}{2}\%$ of the fund. Where this becomes unreasonable is in endeavouring to justify this to policyholders, who can see that, with alternative contracts, there would be a lower deduction going to the shareholders. All of this leads some offices to develop along the lines that were described by Mr Brimblecombe, issuing recurrent single premium contracts and thereby restricting the guarantee to premiums already paid. These guarantees may be simple rather than compound, and the guarantee may be variable. So, for the sake of illustration, it may be half of the gilt yield ruling when the premium is paid. All of these devices have the effect of damping down the shareholders' proportion and enabling the contract to be presented in a more attractive fashion in the market place. There are investment implications with a guarantee of that sort. The guarantee cannot be given without investment in fixed interest; and the higher the guarantee, the higher the proportion of fixed interest and the higher the potential valuation strain.

Mr J. R. Coomber: It is not easy to see how to explain the policy described in the paper so that the ultimate customer can understand it. This is not an original problem. I suggest that when the first with-profits policy was issued, the customer was reasonably mystified as to exactly what he was going to get at the end of the day, but after 100 years or so, policyholders may have become accustomed to what conventional with-profits policies produce and have learnt to understand them. Now how do we explain, in practical terms, what the purchaser of a unitised with-profits policy is going to receive? He might expect to receive something which is, let us say, more volatile than a conventional with-profits policy with a high terminal bonus component, and rather less volatile than a conventional unit-linked policy invested in a managed fund. He might also, relative to the unit linked policy, get the benefit of a guarantee. We need to put it in terms which both the intermediary and the policyholder can have some hope of understanding.

One of the main focuses of our industry, at the moment, is pensions business and, in particular, personal pensions business. Statistics have been quoted, and I believe that there has been a tenfold increase in the volume of annual premium personal pensions business during the past decade. That is an enormous growth in volume. The authors refer to an adaptation of their product to deal with the deferred annuity aspect of our market. What I should like to make a plea for is the annuity in payment. We have people retiring earlier; we have people living longer; so we are moving into the age of what we might call the long-distance pensioner. The product which we have available to him, being largely a sterling product as sold, is not particularly suitable, given inflationary circumstances, particularly over 30 or 40 years. Some adaptation of this policy or of other types of unitised with-profits policies could be used to stimulate demand for an annuity product which has some form of income protection. Such products exist at the moment. So far as I am aware they are not largely sold. Sometimes a new product initiative gives an impetus to a customer message which is worth repeating.

Mr P. A. C. Seymour (closing the discussion): We have received a tremendous variety of comment. It is clear we have a consensus that the paper is topical and that we should have another one soon. Clearly, as the opener said, this paper is rather at the unit-linked end of the spectrum; and it seems that this unitised with-profits concept is one that has been developed more by the conventional companies than the unit-linked ones.

When I read the paper I was reminded of one I wrote in the late 1960s for the Students' Society, which covered maturity value guarantees. Professor S. Benjamin then said, "You cannot do it. You must not offer maturity guarantees." The unit-linked people took the message on board and maturity value guarantees disappeared. What were those guarantees? They were a guarantee to, at least, receive the premiums. What are we talking about here? Some system whereby apparently you can now guarantee a 3½% (or even 4% if you want to pay the shareholders) return on those premiums. It worries me when two speakers suggested that the reason you can do this is that it is paid for, not by the former generation of policyholders, but by the next generation of policyholders. So my question is, "What about when the first generation is the one that fails?" It seems rather like a chain letter. If you are the one that sends it out, you will probably make a profit; but if you are the last one, you almost certainly will not. I do not find that a very sound system.

There is much discussion in the paper about matching, use of options, switching to gilts. All this is familiar and reminiscent of the discussions on maturity guarantees. What it lacks is a decision rule that says, "Here is how you will do it on a systematic basis so that it will work." The modern solution to that question is the protected portfolio approach that Mr Goold mentioned. This question also has serious implications for traditional with-profits policyholders, but they do, at least, have an existing estate—or do they? I do not know any more. They certainly have higher premiums which cover the risk rather better.

So many people were concerned about this issue that there were a number of comments on better ways of designing the approach to get the most effective balance. Mr Needleman offered some comments and Messrs Dumbreck, Snelson and Coomber also reflected on the design questions. Professor Wilkie had some mechanisms to offer. I remain seriously concerned, and I sense that concern in some others—Messrs Scurfield, Hewitson, White, and Wilkie—that we are heading in a dangerous direction. As the authors said, they thought this scheme up as a means of moving away from the unit-linked problems in the event of a crash. To do that, they wanted to offer guarantees.

What causes problems when there is a crash? It is guarantees. There is a danger here which we need to research more carefully.

The paper follows the authors' usual technique of being deterministic. I find that much simpler to follow, but feel we need stochastic tests as well. A number of people have suggested that the higher level of reserves required for with-profits business will actually lead to unitised with-profits seeing the demise of the with-profits conventional or reversionary bonuses. However, I could turn that question on its head, and I could ask, "Is it really that the reserves on the unitised with-profits business ought to be higher?" Mr Purchase touched on this. His answer was that unitised with-profits actually solved the volatility problems and was more helpful as an equitable way of distributing surplus. That is perfectly reasonable, but then we get back to the point that this is just with-profits business managed in a different way!

What has actually happened in practice? I recognise that some of this would be commercial information, but how has the contract sold? One speaker pointed out that it had sold quite well to his sales force. But how did the smoothing formula work in practice? What were the bonus results? How did they compare with conventional results? How often was it necessary to switch from gilts or use options to protect the position? What is the estate now built up from? It is hoped from successful past activity, with the past generation funding the future risks.

The opener said that his reasons for entering the field were to enable switching from unitised with-profits into unit-linked, and Mr Brimblecome touched on that as a reason, and added more. Mr Scurfield said it is helpful for dealing with variable premiums. Motivation is a serious question. Switching from guaranteed funds into unit-linked funds, or the other way when the going gets rough, sounds risky to me. That is potentially an anti-selective option that could cost very heavily indeed.

There was some disagreement about §2.4. Is it so hard to explain to elderly unit-linked flexible whole life policyholders that the mortality charges that we are deducting when they are 90 years old are more than the premiums they are paying? I have no trouble with that at all. That is what happens in an ordinary whole life policy, anyway. Again, some of the rationale for moving it to unitised with-profits may not be as strong as we think. Mr Purchase, too, thought this area was a problem; but that is one reason why there are premium reviews annually at advanced ages. I was pleased there was some support from a speaker who said it was not. You can see in this field we have a situation where N actuaries deliver $N+1$ opinions, and it is going to get worse.

The opener commented, and others supported him, that the guarantee levels on this contract were indeed high. He did not mention that the pension guarantees were presumably on a grossed-up basis 5% *versus* what he regarded as the market norm of 4%. I think that rather confirms his point.

Mr Purchase said at the Convention at Harrogate in September 1989: "It may safely be concluded that developments over the next five years or so will be of more than usual interest". He went on: "Should the profession consider the question more deeply and take a lead in attempting to create an environment in which all categories of business, with-profits, unit linked or any combination, can operate freely and consistently?"

My answer to that is a resounding "Yes". This discussion has made a good start, but it seems to me that a good deal more is needed.

The President (Mr R. D. Corley): If history were to be the only beneficiary of this paper, there would still be justification for giving it a very warm welcome. The story, told in elegant style, of how necessity once again became the mother of invention, should prove to be rich material for generations of researchers into the development of the life assurance industry in this country.

However, it is not only the historians who stand to benefit. Many actuaries working in life offices today are seeking solutions to problems very different from those confronting the authors in 1974, but finding the same solutions. The authors have shown excellent timing in producing their paper, when it is not from the violent fluctuations of unit-linking but from the heavy demands of full with-profits that refuge is being sought in the middle ground. Having reached their particular haven several years before the crowd on the other side recognised the need to take shelter, the authors have now been able to share their experiences in a way which is proving stimulating to those who have followed, and should be of value to those who have yet to follow. As tonight's discussion has shown, we can expect this subject to return to this Hall in many different guises.

I invite you to join me in thanking all our contributors, and in particular in showing our appreciation for the work of the authors.

Mr R. J. Squires (replying to the discussion): Mr Barton reminded you that we had not acknowledged G. L. Melville's paper (*J.I.A.* 96, 311). We had a note to do that. That paper was contrasting unit-linked business directly with with-profits business and terminal bonuses, and it did not cover the same ground directly, but, undoubtedly it was a factor in the generation of our thoughts.

I should like to touch on the question of guarantees and smoothing. Mr Barton said he did not understand why the guarantee for one generation was paid for by the next. I cannot see how it can be paid for by anyone else. If you consider a highly simplified case where you have two investors in a unithised fund who are going to come out at different times, and the first has a guarantee, should the guarantee be operational, it can only be paid for by the second investor.

The technique of exponential smoothing tracks the actual price as long as the growth is equal to the assumed growth in the formula. When, as in 1987, the actual growth is considerably in excess of the assumption, the smoothed price lags the actual price considerably, and we were gratified to find that at the end of 1987, our smoothed price had bisected the down turn in the market.

We commented in §9.3 that the examples we had taken were not intended to represent the worst case; they were merely intended to represent a set of possible variations which gave some indication of what might happen and therefore what should be considered as a sensible investment policy. The important element, and the thing that is different about this contract from a linked contract, is what happens to the dividend income. I must apologise for the fact that we introduced the drop of 10% with the implication that it was a part of the DTI requirements, which it is not. It comes from earlier discussions of maturity guarantees, and we thought it was a sensible variation to build into the model. The point is this: if you have several overlapping generations of policies in a with-profits fund, you have the income from all those generations of investments available to put towards the maturity proceeds of the one maturing generation. If you have the same number of generations of unit-linked policies, each generation is entitled to have its own investment income reinvested at the low prices that operate during that year. That is what makes the significant difference.

The examples chosen were highly arbitrary in order to demonstrate the points that we wished to make. The actual portfolio is considerably stronger, and there was never any question that the guarantees were in any danger.

WRITTEN CONTRIBUTIONS

Mr C. E. Barton: I wish to amplify my remarks on which Mr Squires commented in his reply. Whilst he appeared to be disagreeing with what I had said, he was, in fact, expressing agreement. His simplified example, with only two current policyholders, one of whom is providing a guarantee for the other, accords with what I advocated, i.e. averaging, on a proper charging basis, between current policyholders. What I maintain is wrong, in principle, is attempting to operate a guarantee to be provided by policyholders who have not yet entered into a contract or, for that matter, a guarantee to be provided to future policyholders by their predecessors whose contracts will have terminated earlier.

Mr H. W. Froggatt: In §10.1 the authors stated that they do not expect anyone to be surprised by the results from their models and yet in §8.6 they expressed surprise that 16% of the fund had to be switched to meet a relatively small guarantee problem. As the assumed guarantee cost was largely caused by an assumed 25% fall in the value of equities, it is surprising that £8,000 needs to be put into equities to remove the £370 guarantee costs—rather than say £370/·25, which would be about £1,500. Clearly, if the business in force had been just one year's maturities the amount switched would have been much less. What has happened in the example set out in Table 8.2 is that, because there is only one set of units, the model alters the asset backing of all the business in force to that needed to remove the cost of guarantee on a small part of the business.

The authors note that the longer-term effect of the switch to gilts on price was small. This was partly because there was little difference between the assumed investment performance of gilts and equities. Had the equities risen (or fallen) by 25% during the first year, a larger effect on price would have resulted. The resulting potential inequity would be avoided by having separate series of units for different maturity years (or for different levels of guarantees).

The authors subsequently wrote: We were gratified to be thanked by the opener for providing the opportunity for a discussion of unitised with-profits business. It is not what we had intended to do, but he was clearly right that the opportunity was needed. Having struggled to understand some of the unitised with-profits plans currently in the market, we were surprised by his comment that they were easier to understand than conventional business. We were also surprised by his statement that, under the product structure we discussed, the reserve will normally be greater than the market value of the assets. This can be the case in the early years of the policy, when both the reserve and the asset share are small, but the terminal bonus depends on the asset share being more than the reserve. Prior to maturity or claim, it is treated as surplus reserved for policyholders, not as a liability. We agree with the opener that the terms on which switching is allowed between unit-linked and with-profits contracts need to be considered carefully. Under the product we described, the terms for the unit-linked policy were settled first, and the terms for the with-profits version were then worked out so as to be consistent.

In the matter of advice of the death of the first life under a last survivor assurance, we agree that there would be a risk of under-reserving if no action were taken to find out if one life had died. The protection for the office under the structure described is the existence of the five-year review. At this time the policyholders are contacted to ascertain their required level of cover for next period, and any deaths will come to light.

We have not investigated the cost of the guarantee on the basis of the Maturity Guarantees Working Party's report, because the concept of the contract is fundamentally different. The office has the right to choose the investment portfolio, and has the income from the whole portfolio available to meet a single year's maturities. It is the absence of these factors in linked business that make a guarantee onerous.

Mr White suggested that a massive switch to fixed-interest investments, as described in § 8.8, could be disastrous. We would agree, but would point out that this is a highly artificial example deliberately chosen to demonstrate the points we were discussing. In practice this position would not have been reached, because the need to hold some fixed-interest investments would have been identified earlier. We agree with Mr Froggatt's analysis of why it is necessary to switch a large proportion of the fund in order to meet a modest guarantee. It demonstrates the fundamental conflict between matching and unitisation. One reason for considering the use of traded options is that the guarantees can then be covered with minimal disruption to the general shape of the portfolio. The idea of separate series of units is interesting. We would be interested to know whether conventional offices adjust their asset share calculations in this way.

That thought brings us to the recent paper by R. H. Ranson and C. P. Headdon (*J.I.A.* 116, 301). In that they describe their objective of distributing surplus by reference to their assessment of the excess of the asset share over the guaranteed benefit. The only real difference between their position and ours is that they have to estimate the asset share—we have set up a system to calculate it automatically. We reserve the right to decide precisely how to use the information.

We agree that we should have given some examples of how the exponential smoothing system works in practice. The formula used in the with-profits funds, which are priced weekly, is:

$$\text{New Smoothed Price} = 0.901 \times \text{Old Smoothed Price} + 0.100 \times \text{Current Bid Price.}$$

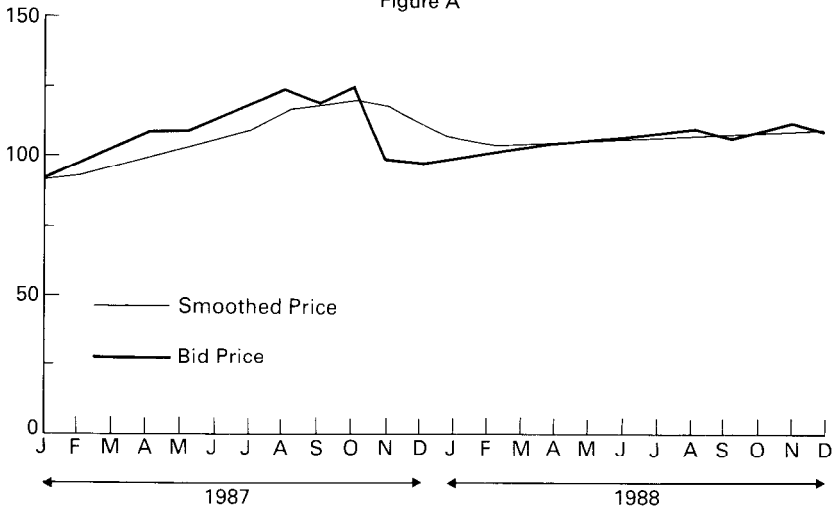
In these funds the bid and offer prices are, in fact, the same. It will be noted that the sum of the coefficients is more than one. The use of this formula is equivalent to saying that the smoothed price is a weighted average of the current bid price and a forecast price based on the previous smoothed price, assuming growth at 6% p.a.

By way of illustration, we show in Table A the actual and smoothed prices at monthly intervals during 1987 and 1988 for the with-profits pension fund, and show these graphically in Figure A.

Table A

Date	Bid Price	Smoothed Price	Date	Bid Price	Smoothed Price
1 January 87	92.90	92.00	1 January 88	99.80	106.60
1 February 87	97.80	93.80	1 February 88	101.90	104.60
1 March 87	103.40	96.80	1 March 88	103.60	104.10
1 April 87	108.00	100.40	1 April 88	105.20	105.20
1 May 87	108.70	103.60	1 May 88	106.40	105.60
1 June 87	112.90	107.10	1 June 88	106.90	106.00
1 July 87	118.60	110.20	1 July 88	109.20	107.50
1 August 87	123.60	115.80	1 August 88	110.00	108.30
1 September 87	119.70	117.70	1 September 88	107.03	109.40
1 October 87	124.30	119.80	1 October 88	109.80	109.50
1 November 87	99.00	117.90	1 November 88	112.10	110.20
1 December 87	97.90	111.20	1 December 88	109.70	111.10

Figure A



The with-profits fund did not exist at the beginning of 1974, but we were employing the exponential smoothing technique for the purpose of determining a suitable value from which to make projections of fund values on unit-linked contracts. For this purpose we calculated a smoothed price quarterly, using the following formula:

$$\text{New Smoothed Price} = 0.85 \times \text{Old Smoothed Price} + 0.16 \times \text{Current Bid Price}.$$

In Table B we show the results of applying this formula during 1973/4 and 5 to a unit trust invested in investment trust shares. The results are shown graphically in Figure B.

Table B

Date	Bid Price	Smoothed Price
31 December 72	29.5	27.38
31 March 73	25.2	27.31
30 June 73	24.4	27.11
30 September 73	24.0	26.89
31 December 73	18.9	25.88
31 March 74	17.2	24.75
30 June 74	14.9	23.42
30 September 74	11.9	21.81
31 December 74	10.7	20.25
31 March 75	16.9	19.92
30 June 75	19.7	20.08
30 September 75	20.1	20.29
31 December 75	20.8	20.57

Figure B

