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REFLECTIONS ON RESILIENCE: SOME CONSIDERATIONS OF MISMATCHING TESTS, WITH PARTICULAR REFERENCE TO NON-LINKED LONG-TERM INSURANCE BUSINESS

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ABSTRACT

The paper considers the valuation for solvency purposes of traditional long-term insurance business. It concentrates on without-profit business, and discusses the reserves that are required to protect against the contingency of sudden adverse changes in asset values (the 'mismatching' or 'resilience' test). The details of a suitable test, and a method of applying it in practice using a 'matching rectangle', are described. Investigations into the effectiveness of such a test, using both deterministic and stochastic methods, are followed by concluding remarks on the underlying philosophical issues raised.

Full numerical results are presented in the Appendices.

God grant me the serenity to accept things I cannot change, courage to change things I can, and wisdom to know the difference.

Reinhold Niebuhr

1. INTRODUCTION

1.1 A year ago the above authors presented a paper, 'Proposals for the Statutory Basis of Valuation of the Liabilities of Linked Long-Term Insurance Business'[1] to the Institute, and subsequently to the Faculty. In that paper ('our earlier paper') it was indicated that consideration was also being given to several other issues, including possible refinements to the Government Actuary's resilience test (see §§ 1.9 - 1.12) and further investigation of the practical application of that test to non-linked business.

1.2 The current paper is the result of our consideration of these two key issues.

1.3 Many readers, particularly those not involved with linked business, may not have studied our earlier paper in detail. To assist them, and for convenience of subsequent reference, the current paper is intended to be self-contained. Accordingly there is, where necessary, repetition of earlier material and duplication of previous ideas – though, it is hoped, no inconsistencies. In particular, the rest of this introduction may be omitted by those familiar with the earlier paper.

1.4 Statutory valuations of long-term insurance business under the Insurance Companies Act 1982 ('the Act', which superseded the 1974 and 1981 Acts) and the Insurance Companies Regulations 1981 ('the 1981 Regulations') have now been prepared by actuaries for some years. Similarly the guidance issued by the profession to Appointed Actuaries, specifically GN1 and GN8, has also remained substantially unchanged over that period (until very recently). The time was opportune for valuation practice to be reviewed in the light of recent experience.

1.5 In particular, in the recent past, considerable attention has been given to the need for actuaries to ensure that their reserves are resilient to financial (and other) changes. A memorandum issued by the Government Actuary to Appointed Actuaries dated 13 November 1985 indicated the magnitude of fluctuations in asset values that he regarded as a reasonable test for this purpose.

1.6 Additionally there were more specific needs in relation to linked business: these were addressed in our earlier paper.

1.7 For all these reasons, therefore, late in 1985 the Institute and Faculty Joint Working Party with the Government Actuary's Department (the 'Joint Actuarial Working Party', or 'JAWP') was re-established to consider these issues. To assist the JAWP, in April 1986 the Institute and Faculty Councils set up a further Working Party, the Joint Research Working Party on Valuation Regulations (the 'VRWP' or just the 'Working Party') to investigate topics within the broad areas described in §§ 1.4 to 1.6, as requested by the JAWP. The members of the VRWP (chaired by Mr D.E. Purchase) are the authors of the current paper. The authors wish to acknowledge the contribution made by colleagues in their various offices who have given invaluable help in preparing the numerical examples and typing the drafts of this paper.

1.8 The remainder of this paper is structured as follows:

The rest of this section summarizes comments on the Government Actuary's resilience test (the 'working rule') made in Section 2 of our earlier paper.

Section 2 sets the working rule into its theoretical and statutory context, and discusses its interpretation, in greater detail than in our earlier paper.

Section 3 describes a spread-sheet model, using a 'matching rectangle', which can be used to apply the working rule to a portfolio of non-linked business.

Section 4 gives the results of investigations into the effect of the working rule on some simple hypothetical combinations of assets and liabilities.

Section 5, in contrast, uses stochastic methods to assess the effectiveness of the working rule.

Section 6 summarizes our conclusions, and returns to the more general issues.

1.9 As already mentioned, in recent years considerable attention has been given, by the Government Actuary's Department (GAD) and by Appointed Actuaries, to the need to ensure that reserves are resilient to financial changes,

as required under Regulation 55. At the First United Kingdom Actuarial Convention, in Birmingham, on 12 September 1985, Mr C.L. Cannon of GAD described the 'working rule' which was being used by the Department when felt necessary[2]. Although there was some initial surprise, actuaries soon became more used to the idea of the test. After the market movements of October 1987 any remaining doubts as to the extent of the fall to be tested are surely academic!

1.10 The test was promulgated more widely through the Government Actuary's memorandum to Appointed Actuaries mentioned in §1.5 (reproduced, with permission, in Appendix 1). In essence the test required actuaries to consider the adequacy of their reserves in the context of immediate falls in asset values of 25% in equities (and similar investments, including property) and also the changes in values equivalent to a rise, or a fall, of 3% in the yields on gilt-edged and other fixed-interest stock. This memorandum was followed by Temporary Practice Note 2 to GN8, issued by the Institute and Faculty to members in May 1986 and contained in the Institute's current Members' Handbook on page D/67 (Faculty page C/33).

1.11 It should be noted at this point that 'mismatching' is here being used in the specific context of a difference between the effect of a change in market yields on the aggregate value of the assets and the effect of the same change on the aggregate value of the liabilities (to quote TPN2). This is sometimes described as 'big bang mismatching' to distinguish it from the 'cash flow (mis)matching' of traditional actuarial theory (the importance of which is also emphasised in the Government Actuary's memorandum). For this reason some have advocated phrases such as 'resilience testing' for the newer concept. Whilst this might be more apt, the 'mismatching' usage is currently dominant. In this paper both phrases will be found, but when 'mismatching' is used it is always (unless specifically stated otherwise) in the context of an immediate change in asset values.

1.12 Whilst on terminology, the GAD test as a whole, including the numerical values set out in §1.10, will normally be referred to in this paper as the 'working rule': the term 'benchmark' is sometimes used with a similar meaning.

1.13 The different sections of this paper represent the results of separate lines of investigation pursued by various members of the Working Party. There is not, therefore, total consistency between all aspects of the different approaches and, where significant, differences are pointed out in the text. We believe, however, that these inconsistencies are not sufficiently material to detract from the results obtained.

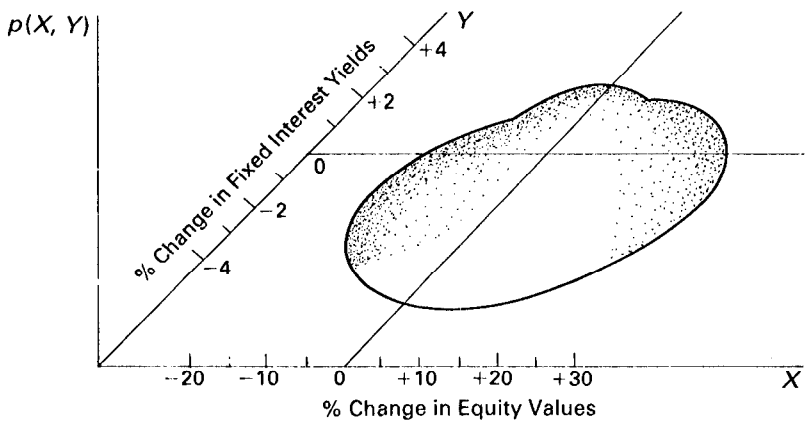
2. OBSERVATIONS ON, AND INTERPRETATION OF, THE WORKING RULE AS IT AFFECTS NON-LINKED BUSINESS

2.1 As a preliminary to an examination of the working rule, it may be helpful to restate some of the comments made in our earlier paper regarding the ambiguities surrounding the interpretation of the working rule test as it applies

to equities and the problem of coherence. The points made on those topics in that earlier paper are equally valid for non-linked business and for ease of reference §§2.6–2.9 are here reproduced as Appendix 2.

2.2 As already mentioned, this paper concentrates on the type of mismatching envisaged in the Government Actuary's memorandum. However, the need for actuaries also to have regard to mismatching of the 'traditional' (i.e. cash flow) type should be borne in mind. The tests apply to the whole of the business of a UK office, i.e. including overseas business. Where a UK actuary is advising an overseas life office (not operating in the UK) the tests are not directly relevant. However, the actuary may feel that in order properly to fulfil his professional responsibilities (see GN5) he should have regard to comparable tests when establishing reserves for such an office. It may be appropriate to note that the application of the tests in the case of a non-EC insurer with a UK branch is not clear, although Regulation 55 would apply to the world-wide DTI returns of such an insurer. It is also appropriate to note that the question of mismatching reserves raises some special issues for reinsurers, particularly where permanent business (unit-linked or with-profits) is reassured on a full co-insurance basis. We have not attempted to address these, or other specialist issues in the current paper.

2.3 It is easy to feel that the hypothecation of assets in the working rule test should have regard to the suitability of those assets in terms of traditional matching. However, our understanding is that such an approach is unnecessary. Under the working rule test, as we understand it, one is purely testing the ability to establish adequate reserves in defined conditions. There is no reason to suppose that an 'unsuitable' asset in the traditional matching sense will be less satisfactory for that purpose than, say, a gilt-edged stock. 'Unsuitability' in terms of the working rule test should be dealt with by the conditions of that test; not by some external attribution of relative suitability. It hence follows that any assets (other than linked assets which are implicitly assumed to cover unit



liabilities) in the office's portfolio can be hypothecated for the purpose of the working rule test.

2.4 Before considering the working rule in detail it is helpful to look at it in a theoretical context. One can visualize a probability distribution for a sudden change to different economic conditions centred on current conditions. If one assumes there are two main components of change, i.e. a rise or fall in the value of equities and property and a rise or fall in the yield on fixed interest assets, then the distribution might take the form of a bivariate probability distribution centred on the origin (representing current conditions), as shown opposite. If one could express the probability of insolvency for the office as a function for every point in the (X,Y) plane, then a mismatching standard could be set by requiring the mean probability of insolvency for the office, weighted by the probability distribution for sudden changes in economic conditions, to be less than some specified standard. It should be noted that such a test would, to some extent, overcome the 'coherence' problem of the working rule. That is, when conditions have changed by, say, -25% and $+3\%$, whether one should then assume a further change of -25% and $+3\%$.

2.5 The actual working rule differs from the theoretical 'ideal' described above in two main respects. Firstly, the tests are required to be carried out at only two points of the (X,Y) plane, i.e. $(-25\%, +3\%)$ and $(-25\%, -3\%)$ although it could be argued that tests at other points, for example $(0, +3\%)$ and $(0, -3\%)$ are also necessary. Indeed, there are occasions where $(+25\%, 0)$ would result in a need for mismatching reserves. Secondly, the condition that needs to be met is of a zero 'probability of insolvency' at the test points, where 'insolvency' means an inability to set up the statutory minimum valuation reserves under the 1981 Regulations.

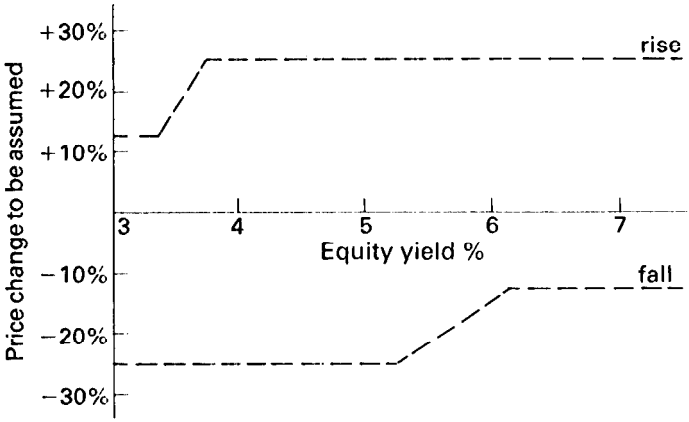
2.6 Variations on the rule can be developed. For example, it may be felt that the variation assumed in equity prices should have some regard to prevailing market levels. As is shown by Appendix 3, UK equity yields have tended to move within the range 3–7%. A possible rule would, therefore, be to modify the $\pm 25\%$ assumption so as to assume price movements which did not take the yield outside that range, subject to a minimum movement of $12\frac{1}{2}\%$ (i.e. half of the normal variation). The practical effect of such a rule would be as shown in the following table:

Prevailing equity yield	*Price changes to be assumed in test*
6·125% or more	+ 25%, − 12½%
5·25%	+ 25%, − 25%
3·75%	+ 25%, − 25%
3·375% or less	+ 12½%, − 25%

(With linear interpolation between 6·125% and 5·25% and between 3·75% and 3·375%)

The limits are shown graphically overleaf.

2.7 A similar approach could be taken to the fixed interest yield variation.



Modified Equity Rule proposed in §2.6.

The effect of a − 3% change in, say, a 5% interest climate arguably represents a far stronger test than was ever intended. A simple modification would be to provide for a fall of the lower of 3% and, say, one-third of the current fixed interest yield. A similar problem exists at high interest rates, particularly in view of the maximum reinvestment rate restriction in the statutory minimum basis. It is suggested that a further rise of only 1½% need be assumed when the prevailing level of interest rates exceeds 15%.

2.8 With the above theoretical framework in mind, the remainder of this section looks at the practical interpretation of the working rule. The two main topics covered are the method of carrying out the necessary calculations and the treatment of other types of asset. The section ends with some comments on currency mismatching.

Calculations under the Working Rule

2.9 The basic approach is set out in §1.10. In determining the minimum reserves it is assumed that the absolute amount of interest or dividend is unaltered by the sudden change in market values of the assets. In determining the maximum valuation rate of interest one has regard to the redemption yield on fixed interest investments after the rise or fall in value and the running yield on equities or property after the fall in value.

2.10 The admissibility limit regulations contained in Schedule 8 of the 1981 Regulations also require consideration. It is possible that assets which are wholly admissible in current conditions will not be so in the changed conditions of the working rule test, or assets which are currently inadmissible will become admissible in the changed conditions. However, in practice the initial hypothecation of assets gives some room for manoeuvre and admissibility is unlikely to be a serious problem.

2.11 Calculating the reserves on the statutory minimum basis in the revised

conditions raises the question of how precisely the minimum reserves should be calculated. The point is of particular relevance in relation to the '7·2% maximum after 3 years' restriction when considering the (− 25%, + 3%) situation. The W_2 and other methods (described in Appendices 4 and 6) would seem to us to be appropriate methods as a minimum basis for valuing non-linked business. In practice it may often not be necessary to go to the extreme of W_2 to demonstrate a certain (or zero) mismatching reserve. Furthermore, these methods may not yet have received sufficient consideration by the profession for them to be regarded as acceptable by the statutory authorities. Whatever method is followed, if contracts include financial guarantees such as annuity options, then care is needed to allow for the necessary reserves in the new conditions.

2.12 The use of a 'matching rectangle' as a way of organizing and summarizing the mismatching calculations may be helpful. Such an approach forms the basis of the practical method described in Section 3.

Treatment of other Types of Asset

2.13 In applying the working rule, as specified, for fixed interest and equity-type assets, corresponding assumptions should be made for other types of asset. This section suggests what those corresponding assumptions should be, although the actuary should, of course, use his professional judgement in deciding the appropriate treatment in particular cases.

2.14 Cash, variable loans, variable mortgages, debts with variable rates of interest and debts due within one year can be assumed to suffer no change in value in the working rule conditions. Similarly, it would seem appropriate to assume no change in value for computer equipment and office machinery etc. in view of the heavy DTI write-down that already exists. Where an asset is income-producing, it seems appropriate to retain the ± 3% assumption.

2.15 For index-linked gilts the broad equivalent of the ± 3% conditions would seem to be a ± 1% change in real gross redemption yield. As an alternative, for simplicity, ± 1% change in the current running yield is suggested. An example might make this clearer. If a stock with a 2% coupon was issued when the RPI was 100 and if the RPI now is 120 then the next half yearly payment of interest is

$$2\% \text{ divided by 2 times } \frac{120}{100} = 1{\cdot}2.$$

The annual payment is thus 2·4. Suppose the price now is 100, then the current running yield is 2·4%. Take the reduced value of the index-linked gilt in the + 1% climate for the purpose of the working rule as $\frac{2{\cdot}4}{3{\cdot}4} \times 100$.

2.16 Fixed interest loans and debentures, all types of convertible loan stocks, preference shares and debts without a variable rate of interest and not due within one year can all be valued using the ± 3% approach. Convertibles should

be valued to the first conversion date. In that respect it should be noted that the somewhat anomalous treatment of convertible stocks standing above their redemption value under the Insurance Companies (Accounts and Statements) Regulations 1983, which can result in negative yields in Form 46 of the DTI Returns, will presumably also apply in this context. (Note: it is understood that in practice the DTI have been prepared to grant a section 68 order allowing such assets to be classed as equities.)

2.17 The treatment of property assets calls for particular comment. When the working rule was first promulgated, properties were not mentioned, though it appeared that they were to be classed as equities for resilience purposes - an interpretation noted in TPN2. It can however be argued that, as the volatility of property values, judging by recent experience in the United Kingdom, is much lower than for equities, a smaller percentage fall should be demanded. Whilst the argument is attractive, the Working Party has some reservations. Reliable data on property values is not available for as long a period as it is for equities. Some overseas experience, both in Europe and elsewhere, suggests that significant falls cannot be ruled out. And the valuation of a property portfolio is itself a more subjective matter than the equivalent for the generality of equity holdings. We therefore feel disinclined to propose a specific different test for property assets, although we would not dissent if a somewhat lower, but effectively arbitrary, percentage fall were to be adopted as standard.

2.18 Warrants, options and traded options etc. are nil yielding and are all wasting assets. Because of the gearing effect, the working rule ought to allow for a much larger drop than that applicable to equities and property. For simplicity the assumption of a 50% reduction in face value is suggested. In the case of a futures contract it seems appropriate to regard it as a basic investment coupled with an option and to consider each part separately in accordance with the relevant treatment.

2.19 It is worth noting two other points regarding the treatment of assets. Firstly, in the initial hypothecation exercise it will normally be possible to avoid the complications of including minor classes of asset such as traded options in the hypothecated assets. Secondly, although the inclusion of non-interest bearing assets, where no change in value need be assumed, reduces the volatility of asset values in the working rule conditions, there is a trade-off in that the inclusion of such assets depresses the yield thereby increasing the stringency of the minimum basis.

Currency Mismatching

2.20 The actuary should also have regard to any mismatching by currency between assets and liabilities. (The possible extent of such mismatching is, of course, limited by Regulation 25.) There seems no simple logical extension of the working rule tests which could be used to determine the reserves required to cover such mismatching. However, it could be considered appropriate for the size of the currency fluctuations to be assumed to vary according to the stability and relative strengths of the currencies concerned, for example by assuming a

larger change in value than 25%. It is also worth noting that a depreciation in value of an asset denominated in a foreign currency due to exchange rate movements has no effect on the yield on that asset (in the relevant currency). The effects of such depreciation are, therefore, generally more dramatic in terms of the consequent need for a mismatching reserve than a comparable reduction in value of a sterling asset due to a yield change. In the above discussion it has been implicitly assumed that there is no mismatching by currency, but such mismatching would seem an area worthy of separate consideration. The position of overseas business needs especial attention in that connection.

3. A PRACTICAL METHOD OF APPLYING THE WORKING RULE

3.1 This section looks at the calculations required in respect of non-linked business. No reference is made to linked liabilities or to current liabilities.

3.2 To demonstrate compliance with the maximum valuation interest rates defined in Regulation 59, assets can be notionally apportioned to various categories of liabilities. For this purpose the assets are taken at the values indicated by the asset valuation regulations (broadly market values), corresponding to the fact that Regulation 59 defines yields in relation to such values. On this basis, the amount of assets available for notional apportionment will normally exceed the amount of liabilities, so there will be some latitude in which assets are selected for this exercise, as well as in how they are notionally apportioned. The amount of liabilities covered will be the total mathematical reserves including cost of bonus (i.e. Form 14 lines 11 plus 15), plus any additional amount held in respect of contingent liabilities (e.g. contingent tax on capital gains) as will be mentioned in the footnote to Form 14. At this stage the mismatching reserve itself will not be included, because this is the beginning of the process by which its amount is determined, although there will be a presumption about which further assets will be available for apportionment to it when it has been calculated.

3.3 In complying with Regulation 59, the highest permissible valuation interest bases (and hence the minimum reserves) will be achieved if the assets are considered in descending order of gross yield, up to the amount of the liabilities, with the lowest-yielding assets omitted. However, this order of yield may not be the same after a move to one of the working rule conditions (especially '– 25%, – 3%'), and to demonstrate compliance with the Regulations in those conditions it is permissible to make use of a completely different apportionment. Thus, within this overall approach, assets can be apportioned notionally to the liabilities in the most appropriate (or most expedient) way at any stage, as discussed in § 2.3, so as to minimise the resulting mismatching reserve, having regard to the respective volatilities of assets and liabilities.

3.4 In the method described in this section it is, accordingly, assumed that the assets are considered in descending order of gross yield. The outcome of applying the method is shown in Appendix 5 and the following references to tables are to tables in that appendix.

3.5 Table 5.1 shows how the notional apportionment can be set out in the form of a 'matching rectangle', showing which assets are apportioned to which liabilities. In the example:

(i) The figures are for illustration of the method, and are not intended to carry any message about the results.
(ii) Only a limited range of categories of liabilities is shown. In practice the range of classes of business and of different valuation bases may call for a much larger number of categories, as indicated in Table 5.7.
(iii) The number of categories of assets is also limited, and in practice a wider range may also be used here, as indicated in Table 5.8. In particular, fixed interest assets could usefully be analysed by outstanding term.

In practice inclusion of the valuation rates of interest for the liabilities and of the yields (less margin) for the assets would make the table a convenient working sheet for demonstrating compliance with maximum valuation rates of interest.

3.6 On a move to one of the working rule positions, the requirement is to have sufficient reserves to continue to cover the minimum liabilities calculated in accordance with the Regulations. This means that a new notional apportionment of assets can be made, but in the simple example illustrated in Tables 5.1 - 5.3 the same apportionment is retained. On application of the working rule the total values of the assets will alter accordingly, and for a given class of asset the values of the individual amounts apportioned to each category of liability will alter in proportion to the alteration in the total value for that asset. For example, in the column headed 'Land' in Table 5.2, the asset values are each 75% of the corresponding value in Table 5.1. At the same time, each category of liability is re-valued on a basis corresponding to the statutory minimum in the new conditions. For example, it is assumed that the total liability in the general annuity fund is reduced from 9,880 (Table 5.1) to 7,885 (Table 5.2). Hence, in the row 'General annuity fund' each figure for liabilities in Table 5.2 is 7885/9880 of the corresponding figure in Table 5.1.

3.7 For each cell in the matching rectangle there is now a new asset value and a (different) new liability value, showing a surplus or deficit for the cell. For the example in Table 5.1 the revised position is as shown in Table 5.2. This shows an overall deficit of 45,692. In this example, and assuming that higher yielding assets have already been apportioned, this will mean a mismatching reserve in the form of a further 60,923 (= 45,692/0.75) of equities at current values. With the addition of this amount, the revised total value of apportioned assets in the working rule conditions will now be equal to the revised total liabilities. An example of an apportionment of this total is shown in Table 5.3. As in Table 5.1 asset yields are also shown.

3.8 The full detail is not essential to the process of arriving at a mismatching reserve, but it does give a useful picture of how its amount arises and which parts of the portfolio contribute most to it. It can also give a lead to where significant mismatching occurs, and to whether a different notional apportionment of assets might be appropriate, either in the current conditions or in the working

rule conditions. Because of the interactions between the apportionment of assets and the minimum valuation bases for the various categories of liabilities, a number of trial calculations may be needed. Alternatively, a systematic mathematical approach to minimizing the mismatching reserve is possible.

3.9 When a matching rectangle has been set up in this way for a working rule, each cell shows the effect for one category of liability backed by one class of asset and, as will be seen, corresponds to the sort of single result described in Section 4 for an individual theoretical case. By starting from results of the kind shown in Section 4 and setting them out in a matching rectangle format, the position of any office can be considered as the combination of a number of such theoretical cases with suitable weightings.

3.10 Whether analysing a given total portfolio or building up to a hypothetical portfolio from simple components, it should be noted that successive approximations may be needed to arrive at a set of valuation bases which individually and in total come as close as possible to the statutory minimum valuation basis. Also, because of the freedom to use different groupings of liabilities, different notional apportionments of assets to liabilities and different mixes of stronger and weaker valuation bases, the calculations can in one sense be regarded as a purely theoretical exercise to find the minimum mismatching reserve which will satisfy the working rule.

3.11 If an office's published valuation is at the statutory minimum, which is the assumption for the hypothetical situations considered in Section 4, mismatching reserves will normally be required. In practice, the published valuation bases used will usually be stronger in various respects than the statutory minimum, and there may be various non-specific additional reserves. To the extent that there is no other contingency that these margins and additional reserves are deemed to cover, they can be used towards the required mismatching reserve, or indeed be treated as being the mismatching reserve, or part of it. As a result it may be found that the explicit mismatching reserve can be reduced or extinguished, even though it would have been needed if the published liabilities were calculated on the statutory minimum basis. It should, however, be noted that the actuary should ensure that any mismatching reserves would enable him to set up office reserves in the changed conditions which he would regard as adequate. Those would not necessarily be at the statutory minimum level in the new conditions, but may need to be at some higher level. It should also be noted that, although the Government Actuary's memorandum specifically states that Regulation 55 need not be met in the changed conditions, the requirements of Regulation 54 would appear to continue to apply. Each actuary needs to have regard to the circumstances of his own office in applying the test.

3.12 The example illustrated in Tables 5.1–5.3 of Appendix 5 makes no reference to any provision for contingent tax on capital gains (that is, the prospective liability to tax on capital gains which would arise on the sale of the assets to which it applies). As mentioned in §3.2, this may be part of the 'additional amount' which has to be mentioned in the footnote to Form 14 of the DTI return, and in practice it is helpful to consider the two together.

Contingent tax on capital gains can be included as a category of liability in the matching rectangle, and in the working rule conditions it will have a different value (depending on the relevant capital appreciation, less indexation, and the proportion of assets deemed to relate to taxable funds). In general, this will mitigate the effect of a fall in capital values. An example is shown in Tables 5.4–5.6, which correspond to Tables 5.1–5.3.

3.13 In the example, the contingent tax on capital gains (referred to as 'contingent CGT') is taken as 10,000 in current conditions, reducing to 1,000 in the '+3%, −25%' condition. The effect of holding assets equal to this contingent liability of 10,000 is to reduce the further amount needed in respect of mismatching reserves (as compared with the amount illustrated in Tables 5.1 - 5.3), and the two are clearly inter-related.

3.14 Whatever the details of the calculations, the resulting mismatching reserve is, of course, a minimum figure. The figure actually published must also satisfy the professional judgement of the actuary, including ensuring compliance with Regulation 54.

4. IMPLICATIONS OF THE WORKING RULE FOR HYPOTHETICAL ASSET AND LIABILITY COMBINATIONS

4.1 In this section, a number of hypothetical situations are considered in which assets of one particular type are regarded as 'matching' liabilities for contracts of one particular type. The types of asset considered are equities (taken to include property), fixed-interest securities, short-term deposits (taken to include variable interest securities, mortgages and loans) and 'cash' (taken to include net current assets). The types of contract considered are whole-life assurances, endowment assurances and temporary assurances in the life assurance fund, and immediate annuities and deferred annuities in the pensions business fund. Where appropriate, both single premium and regular premium, and without-profits and with-profits contracts are considered.

4.2 Besides having liabilities in respect of its long-term contracts, a life office will also have various current and contingent liabilities which would be included within Form 14 of the DTI return. These will either be 'fixed' in the sense that they will not vary with investment conditions (e.g. outstanding claims, commission) or 'variable' (e.g. provisions for contingent tax on capital gains). For completeness, two further categories of liability are thus considered, namely 'fixed' liabilities and 'capital gains tax' liability. As well as covering current liabilities, 'fixed liabilities' might also be a suitable classification for liabilities in respect of some types of deposit administration contracts – this will depend on the precise terms of the contracts.

4.3 An alternative approach to the treatment of the provision for contingent tax on capital gains would be to apportion this provision to the individual equity and property holdings. In assessing the effect of a 25% reduction in the market value of equities and properties, the consequent reduction in the provision required for contingent tax on capital gains would be taken into account and the

market value (net of contingent tax provision) would reduce by less than 25%. While this alternative method might in some cases be of practical use to an office, the first method outlined above has been used for this exercise.

4.4 In the case of equities or property, under the working rule assets currently of value A would reduce in value to 0.75A while a dividend yield of i% would increase to $(4i/3)$%. The yield taken into account must not exceed the yield on $2\frac{1}{2}$% Consols. This limit is most likely to have an effect (if at all) in the '-3%, -25%' test. For this investigation alternative current equity yields of 3% and 6% are considered. It is noted in passing that the yield shown in Form 45 of the DTI return for equities is effectively a rate convertible half-yearly since it is obtained by dividing the expected income for the following year by the current asset value, whereas the yield for fixed-interest securities is a gross redemption yield (i.e. convertible yearly).

4.5 In the case of fixed-interest securities, under the working rule assets currently yielding i% would yield $(i + 3)$% or $(i - 3)$%. The effect on asset values would depend on both the coupon and the outstanding term of the stock. The table below shows for fixed-interest stocks redeemable at 100 with coupons 5%, 10% and 15% and outstanding terms 5, 10, 15, 20 and 25 years the values assuming gross redemption yields of 7%, 10% and 13%. Columns (6) and (7) of the table show the reduction in asset values when moving from a yield of 7% to 10% and from 10% to 13% respectively.

(1) Coupon	(2) Outstanding term	(3) 7% value	(4) 10% value	(5) 13% value	(6) Ratio of (4) to (3) %	(7) Ratio of (5) to (4) %
5%	5	92·15	81·51	72·42	88	89
5%	10	86·56	70·03	57·44	81	82
5%	15	82·57	62·90	49·32	76	78
5%	20	79·72	58·47	44·91	73	77
5%	25	77·70	55·72	42·51	72	76
10%	5	113·01	100·93	90·56	89	90
10%	10	122·28	101·50	85·43	83	84
10%	15	128·89	101·86	82·65	79	81
10%	20	133·60	102·08	81·14	76	79
10%	25	136·97	102·22	80·32	75	79
15%	5	133·86	120·34	108·70	90	90
15%	10	158·00	132·97	113·42	84	85
15%	15	175·21	140·81	115·98	80	82
15%	20	187·49	145·68	117·37	77	81
15%	25	196·24	148·71	118·12	76	79

4.6 It will be noticed that the outstanding term is a more significant variable than the coupon (and that this is consistent with the requirement for an analysis by outstanding term in Form 46 of the DTI return). In view of this a single coupon has been used in the calculated examples, with 10% chosen because life offices typically tend not to purchase low-coupon stocks. Stocks of outstanding terms 5, 10 and 25 years are used in our investigations.

4.7 Regulation 59 of the 1981 Regulations requires that the rate of interest used for valuing liabilities should not exceed 92½% of the yield currently applying to the appropriate assets. The Regulations further require that for investments to be made more than 3 years after the valuation date the valuation rate of interest must not exceed 7·2% gross. However, as explained in Appendix 6, this restriction is not wholly compatible with the modified net premium method ('W_3') used and has accordingly not been rigidly adhered to in our investigations.

4.8 At the time of writing, the life office tax rate for unfranked income is 35% and for franked income is 25%. Tax rates in the future can only be a matter for speculation. Although the recent trend has been downwards, it has been considered reasonable to adopt a uniform rate of 35%. This leads to a maximum re-investment rate (after 3 years) of 4·68% 'net' for life fund contracts.

4.9 Besides having to establish mathematical reserves for its long-term contracts, a life office has to hold assets sufficient to cover its solvency margin. Just as any change in the value of equity or property values affects the attendant contingent capital gains tax provision, so any change in the amount of the mathematical reserves resulting from a change in investment conditions affects the amount of the attendant solvency margin. It is generally considered that provision for solvency margins in the changed conditions is not intended to be part of the working rule. However, for the purpose of this exercise, a rigorous approach has been adopted. Although it is normally a second-order consideration except in the case of temporary assurances, the change in the amount of the solvency margin has been taken into account in the calculation of the mismatching reserve.

4.10 In the case of pension fund and general annuity fund contracts, reductions in liabilities can result in an increase in the liability to Case VI tax on profits. There could in practice be other 'knock on' effects on the tax computation. Any such effects have been disregarded.

4.11 In assessing the amount of mismatching reserve, an assumption has to be made as to the nature of the assets underlying the reserve. The assumption made in Section 3 is that an office will allocate assets to liabilities in descending order of yield with the result that the assets available for the mismatching reserve and free assets would be the lowest yielding assets (most likely equities or property). However, for the purpose of this exercise it has been assumed that the assets underlying the mismatching reserve are of the same type as those underlying the basic liabilities.

4.12 The amounts of the mismatching reserves for a range of hypothetical asset and liability combinations are shown in the tables in Appendix 7.

4.13 Mortality tables used are A67/70 ultimate for assurances and $a(90)$ ultimate for annuities. Liabilities are, where appropriate, valued on the modified Zillmerised net premium method described in Appendix 6. A bonus rate of 5% p.a. compound is assumed for the whole-life and endowment assurance contracts and of 7% p.a. compound for the deferred annuity contract.

4.14 While the practical method of applying the working rule described in

Section 3 is likely to lead to minimum mathematical and mismatching reserves, for certain categories of liabilities the assets allocated might be unsuitable having regard to the type of liability and expected amounts of benefits to be paid under the relevant contracts. However, as discussed in §2·3 we do not see that as an issue. The wider matter which is mentioned in §3·11 should, however, be considered. That is, whether the mismatching reserves would enable the actuary to establish office valuation reserves in the changed conditions which he would regard as adequate.

4.15 Such considerations are particularly relevant to with-profits contracts where, for example, investment in high-yielding fixed-interest securities is unlikely to be the actual investment strategy adopted by the office for these contracts. Nor would a valuation using the resulting yields be likely to produce reserves which the actuary would be able to certify as adequate having regard to Regulation 54. This leads to the vexed question of the 'reasonable expectations of policyholders' (section 37(2) of the Act) and the extent to which allowance ought to be made for future bonuses when assessing the amount of the liabilities.

4.16 In a report presented to the Faculty of Actuaries in 1984[3] the Faculty Working Party on the 'Solvency of Life Assurance Companies' commented as follows:

> "2.3.2. It does not seem to us reasonable for policyholders to expect that the current level of bonuses declared by the company concerned should be maintained throughout the rest of the term of their policies, let alone increased. Nor, therefore, does it seem reasonable for prospective policyholders to expect that illustrations given at the time they effect policies should necessarily be fulfilled in practice. On the other hand, it is scarcely reasonable to assume, either for current or immediately prospective policyholders, that no bonus whatever should be payable.
>
> 2.3.3. It may be thought a reasonable compromise that with-profit policyholders could expect at least the level of bonus in future which would be earned by the bonus loadings inherent in their premiums were the expenses, investment and mortality assumptions underlying the non-profit premiums chargeable by the company concerned to be experienced in future. This level of bonus might well for a typical U.K. with-profit company be something like one half of current bonus levels and we, therefore, suggest that reversionary bonuses at this level could probably be considered a reasonable expectation for participating policyholders."

4.17 If this view is accepted, the conclusion would follow that reserves would be unsatisfactory if they were insufficient to enable bonuses to be paid in future at a level appropriate to the changed investment conditions. For example, an increase of 3% in fixed interest yields would be unlikely in practice to result in a reduction in reversionary bonuses – just the opposite – and consequently reserves which were sufficient only to support reversionary bonuses at a reduced level would be unsatisfactory. Although reserves would be calculated on a net

premium method, their adequacy would of course be tested using a bonus reserve method. This approach would need to be followed through to the mismatching calculations.

4.18 The contrary view would be that the test is purely one of solvency in the changed conditions and that future bonus prospects do not have to be taken into account. In that case one is only concerned with reserves on the statutory minimum bases. This is the approach adopted for this exercise, but that should not be taken as an endorsement of the approach.

4.19 Terminal bonuses are now a common feature within the bonus structure of offices transacting with-profits business, but practice varies as regards reserving bases. Most offices make no explicit allowances within reserves, some hold an additional reserve equal to the expected cost of terminal bonuses for the following year only, whereas others set aside more substantial reserves to meet the accrued cost of terminal bonuses. If reserves in respect of terminal bonus are established, then that approach has mismatching advantages. If equity values reduce by 25% but fixed interest yields remain unchanged, the likely reaction of an office would be to reduce terminal bonus rates but to leave reversionary bonus rates unchanged. Lower terminal bonuses would naturally result in lower reserves being required for terminal bonuses. In other words, any reserve for terminal bonus can play a further role as a mismatching reserve to cover a reduction in equity or property market values. That effect is not surprising since the office reserves are, of course, higher than would be the case if no reserve for terminal bonuses was held.

5. USE OF STOCHASTIC METHODS TO ASSESS THE EFFECTIVENESS OF THE WORKING RULE

5.1 The objective in this section is to consider the reasonableness or otherwise of the working rule and whether the profession should recommend any modifications to it, or any alternative (or additional) standards. The reasonableness of the benchmark approach is considered in relation to matching on a cash flow basis, comparing asset proceeds with liability outgo. Tests have been carried out on some of the non-profit examples considered in Section 4. No tests have been carried out on with-profits business in view of the complications which arise in devising an algorithm for determining the bonus rates from year to year for each trial. It is felt that the results for non-profit business should provide a reasonable guide to the effectiveness of the working rule. In the investigation 'solvency' is taken to have its colloquial sense - that is, the matter of the point at which the authorities would intervene in practice is not considered.

5.2 In order to carry out a cash flow projection, assumptions are required as to future financial conditions. The approach adopted below is to use a stochastic model whereby a large number of trials are carried out, each producing a set of future values for the Retail Prices Index, the yield on fixed interest stocks and deposits (assumed to be uniform at any point of time), equity prices and equity dividend yields. The outcome of each trial is considered equally likely (or

unlikely!) to occur in practice. The adequacy of the assets backing the liabilities is assessed by carrying out a cash flow projection using the results of each trial. By carrying out a suitably large number of trials the probability that the assets are adequate can be determined.

5.3 The stochastic model chosen for the purpose is that developed by Mr A.D. Wilkie[4]. The parameters adopted are based on Wilkie's 'Full Standard Basis' which includes initial values as follows:

Rate of inflation	5% p.a.
Dividend yield	4% p.a.
Yield on consols (used for fixed interest stocks and deposits)	$8\frac{1}{2}$% p.a.

but different yield figures have been substituted according to the scenario under test. The rate of tax on income has been taken as 35%; tax on capital gains has been ignored. Any method of determining probabilities relating to zones of the funnel of doubt must be used with reservation particularly if attention is being paid to the outer regions. The reliability of the answers brought out by using a model can be only as good as the assumptions underlying that model: however the Working Party considers Wilkie's model suitable for the purpose of this investigation.

5.4 In carrying out the projections, the income comprised:

Premiums (gross office premiums)
Investment income (net of tax)
Redemptions of fixed interest stocks

and outgo comprised:

Death claims
Maturities
Expenses (net of tax relief).

When outgo exceeded income, disinvestment was necessary; this was carried out in the order:

Cash and deposits
Redeemable securities (shortest terms first)
Irredeemable securities
Equities.

If income exceeded outgo new investment could have been made and this is considered in §§ 5.9 and 5.10.

5.5 For the purpose of the calculations various assumptions have been made. It should not be construed that the Working Party necessarily regards all these assumptions to be appropriate to the circumstances of a typical life office. The assumptions used were as follows:

(i) The mortality table used was A1967-70 Ultimate. It could be argued that in a stochastic model deaths should be deemed to occur according to an

appropriate statistical distribution. As it is the effect of the investment conditions in which we are interested it was considered acceptable to treat mortality deterministically.

(ii) Expenses for endowment assurances and whole life assurances were taken at the rate of £9 p.a. per policy (before deducting tax relief) at the valuation date increasing in line with the projected RPI figures for the trial.

(iii) In order to avoid further complications in the model, no provision for withdrawals has been made. It might, in any case, be argued that provision for withdrawals is not necessary as no account of these is taken in the valuation (subject to the reserves being adequate to cover surrender values).

5.6 In determining each net premium when calculating the valuation reserves, the only modification to the pure net premium which has been made is to restrict it to 95% of the office premium. This contrasts with the calculations described in Section 4 and in Appendix 6; there, the 'W_3' modification has been made and a Zillmer adjustment has been introduced. Consequently those figures are not strictly comparable to the results of this section.

5.7 Paragraph 5.2 refers to the probability that the assets were adequate. We shall use the term 'probability of ruin' to denote the proportion of trials where the holding of assets is exhausted before the liabilities have run off. Other approaches are, of course, possible - e.g. looking at the distribution of the time before the assets are exhausted or the probability that they are exhausted within a specified number of years. However, it is desirable to be evenhanded between offices with long and short term liabilities.

5.8 The interpretation of a 1% probability of ruin is not necessarily that 1 in 100 offices will fall by the wayside before existing liabilities run off; since all offices are subject to the same external economic conditions it could mean that there is a 1 in 100 chance that many offices will become insolvent! To obtain the probability of ruin a large number of trials is required. The results below have been based on 10,000 trials where the assets include equities and 5000 trials otherwise. Even so, it is evident that a greater number of trials is necessary to make the results shown in the tables in Appendix 8 accurate to the number of significant figures shown.

5.9 There are many different assumptions one could make when investment is to be made at a future point of time. These include:

(i) Investment in a manner having regard to the remaining liabilities - i.e. assume that the investment manager has regard to cash flow matching or to immunisation;

(ii) Investment in the same securities as are already held;

(iii) Investment in cash on deposit.

The first of these would be difficult to program. In any event if there is to be cash flow matching or immunisation in the future one might just as well reorganize the current portfolio at the start. This would be tantamount to having no regard whatever to the existing assets.

5.10 Some trials were carried out using methods 5.9 (ii) and 5.9 (iii). The probabilities of ruin were generally greater and more widely dispersed with method (ii) than method (iii). This is probably because the fortunes of investments in other than cash are dispersed more widely about the mean. Bearing in mind that only without profits business is being investigated, investment in cash has been adopted. This is a stringent approach since, in practice, the investments may be managed in a manner which would reduce the probability of ruin.

5.11 One way to tackle the investigation would be to decide what probability of ruin to regard as acceptable and then to determine what holding of the particular type(s) of asset being considered is needed to bring the probability of ruin down to the selected level. One could then determine a rule (such as $\pm 3\%$, $\pm 25\%$) to approximate to this. The first problem is fixing an acceptable figure for the probability of ruin. The recommendations in the Report of the Maturity Guarantees Working Party[5] feature a probability of ruin of 1%. In considering the suitability of a particular level it must be remembered that margins have been introduced – the stringency of the future investment assumptions (see §§ 5.9–5.10), the assumption that there are no withdrawals, and the cushion provided by any with-profits business where the bonus rates could take the strain. More relevant is the fact that we are considering a single asset against a single liability; the risks associated with a portfolio of assets backing a portfolio of varied liabilities will generally be much smaller than the risks attaching to subsets of the portfolios taken in isolation. This is considered further later.

5.12 It is not possible to input a probability and derive the asset value without recourse to an iterative method where various asset values are used for the starting points and one successively homes in on the required answer. In our work, no attempt was made to 'solve' for the desired asset value; only asset values based on the working rule were used.

5.13 The statutory minimum valuation basis requires a $7\frac{1}{2}\%$ margin on the asset yield and an assumed maximum reinvestment rate of 7·2% p.a. (the three year period has been ignored for convenience in the calculations carried out in this section). It can be argued that both of these margins are to cover contingencies which the provision of a mismatching reserve is intended to cover. Trials have been carried out with and without those margins being included. The solvency margin has been ignored.

5.14 Calculations have been carried out for non-profit endowment assurances (where a sum assured of £5,000 has been assumed) and for non-profit whole life assurances (for which a sum assured of £10,000 has been assumed) backed by a range of different types of investment as in Section 4. The results are shown in Tables 8.1 - 8.9 in Appendix 8.

5.15 The following amplifies the descriptions in the headings to the tables:

Columns (1) and (2) - These give details of the asset assumed to be backing the liabilities and are as in Section 4.

Column (3) - This is the yield assumed to be available on the asset at the valuation date.

Column (4) - For the purpose of calculating mismatching reserves a sudden change to this yield is assumed. In the case of equities, this is a consequence of a 25% change in market value, assuming that the income remains unchanged.

Column (5) - It is assumed that assets are held of value equal to the liabilities determined using a rate of interest, net of tax, based on $92\frac{1}{2}\%$ of the yield shown in column (3) and subject to a maximum of 7·2% p.a. Trials are then carried out as described in the preceding paragraphs and the resulting probability of ruin is shown in column (5).

Column (6) - If the yield were to change immediately after the valuation date to that shown in column (4) from that shown in column (3), the holding of assets at the valuation date would need to be changed (generally increased) to an amount before the change in yield such that after the change in yield it would become equal to the liabilities determined using a rate of interest, net of tax, based on $92\frac{1}{2}\%$ of the yield shown in column (4) and subject to a maximum of 7·2% p.a. Column (6) shows the percentage increase in the holding of assets at the valuation date resulting from this change.

Column (7) - Trials are carried out assuming this increased holding of assets and the resultant probability of ruin is shown in column (7). Exceptionally, where the holding of assets does not increase, no figures are shown in columns (6) or (7). Current financial conditions are assumed at the start of each trial.

Columns (8) and (9) - In determining the amount of assets needed for the purposes of columns (6) and (7) the valuation rate of interest was derived subject to the $92\frac{1}{2}\%$ and 7·2% p.a. limitations. For the purposes of columns (8) and (9) these limitations have been disregarded. However, in some instances the holding of assets decreases from that derived as in the description above for column (5) and in such cases no figures are shown.

5.16 Most of the probabilities of ruin shown in columns (7) and (9) of the tables may be regarded as acceptably low although some are rather higher and in a real situation could give rise to concern. However, there are many instances where the figures in columns (7) and (9) are lower than any standard likely to be set in practice, indicating that the additional reserves demanded by the working rule are more than really necessary; indeed there are many instances where column (7) is little smaller than column (9) indicating that the additional assets required do not give a significant improvement in the probability of ruin. The conclusion is that for many of the combinations of asset and liability the need to meet the ($\pm 3\%$, $\pm 25\%$) test and at the same time satisfy the statutory limitations on the valuation rate of interest is too strong while for some of the combinations the test is too weak.

5.17 It was mentioned in § 5.11 that risks associated with portfolios of business should be smaller than those for single specimen policies. Some further tests have been carried out for a portfolio of non-profit endowment assurances and whole life assurances and the results are shown in Table 8.10. The portfolio used

consisted of endowment assurances of term twenty years without profits with maturity dates spread over the first twenty years together with some whole life assurances without profits effected by a 30-year-old and now at various durations. The liability outgo was substantially heavier in the first twenty years than subsequently.

5.18 The results in Table 8.10 do not present any real surprises. All the figures in column (7) are low except those for equities. It is interesting to note from the fourth line of the table that for a short term fixed interest stock the limitations on the valuation rate of interest represented by columns (8) and (9) do provide a necessary margin. For the longer term stocks, it is evident that the margins are unnecessary.

5.19 It would obviously be possible to extend the tests to other classes of business and other combinations of assets and liabilities. It would also be possible to use the method to test variants of the working rule. For instance, one could consider rules such as those discussed in §§ 2.6–2.7. The Working Party feels that there is not sufficient pattern in the results being produced for it to become clear that one type of rule is preferable to another.

6. REFLECTIONS ON RESILIENCE

6.1 The bulk of this paper comprises a detailed factual investigation of the current working rule, and suggests ways in which it can be applied in practice. In summarizing the main conclusions reached in our work, it may also be appropriate to stand back from the detail and address some of the more fundamental underlying issues, in the hope that our views on these will help to focus the discussion on principles rather than detail.

6.2 Although the working rule is, at first sight, a straightforward mechanistic operation, in practice there are a number of ambiguities in precisely how it should be applied. A number of those are described in Section 2 and suggestions are made for the logical development of the rule as necessary.

6.3 Despite the ambiguities described above, in general the working rule is not difficult to apply in practice. A helpful way of organising the work with a practical methodology is given in Section 3.

6.4 Sections 4 and 5 are in many ways the heart of the paper. A number of hypothetical simple portfolios are examined as a first step towards answering the question 'does the working rule produce logical results in practice?'. The results of Section 4 show a somewhat mixed picture. Looking, for example, at the results for a without-profits endowment assurance of remaining term 5 years the lowest mismatching reserve arises when the outstanding term of the matching fixed interest stock is also 5 years. That seems a logical position. However, it is less clear that it is appropriate to require a higher mismatching reserve for equities backing a with-profit endowment assurance than if the same assets are backing a comparable without-profits policy, although that feature appears to be due to the effect of the net premium valuation method. A number of other similar observations can be made.

6.5 Some illogicality of effect is only to be expected in such a simple rule and the results in Sections 4 and 5 should not be regarded as surprising. In general, the test exhibits reasonable consistency of effect where the match is one which is intuitively sensible, but is less satisfactory where there are more unusual combinations of asset and liability. Despite that drawback, we conclude that the working rule test is as satisfactory as any other simple test is likely to be. However, we recommend that consideration be given to modifying the test in conditions which are, historically, extreme along the lines suggested in §§ 2.6 and 2.7.

6.6 Turning to the wider issues, the first relates to the strength of the resilience test that should be applied as a 'standard'. It is intuitively clear (and is confirmed by the work already presented in this paper) that no test can be equally stringent for all offices, or at all times - and nor indeed should it be. More appropriate, perhaps, is to consider the 'objective' severity of the test, in the sense of the likelihood of the described fluctuations actually occurring within a fairly short period (months rather than years). It is our view that a test based on detailed statistical analysis is out of place in this particular discussion: the precise test is, ultimately, arbitrary and a broad measure of severity is all that is required.

6.7 In § 2.9 of our earlier paper, reproduced in Appendix 2, we concluded that the current working rule described market fluctuations that might be expected every decade or so. This view has not altered. As such we believe that the test represents a reasonable minimum standard of severity, which companies should be able to meet without difficulty unless economic circumstances are extreme. There seems to be no overwhelming justification for insisting that a significantly more severe objective test should be imposed as a matter of course, though we accept that the GAD is reasonably entitled to ask Appointed Actuaries for further comments on their companies' mismatching position where this seems necessary. While such enquiries could extend to more severe tests than the working rule imposes, this should be (as indicated in the Government Actuary's 1985 memorandum) in the context of cash flow mismatching and a gross premium valuation. The artificialities and constraints of the net premium valuation required by the current regulations render any test more severe than the current one inappropriate, in our view.

6.8 A particular component of the strength of the resilience test occurs in the discussion on yield and earnings effects. These were considered in §§ 2.7 and 5.9 of our earlier paper, and we do not wish to add to those comments; we would merely reiterate that the '$7\frac{1}{2}$% of yield' margin should be subsumed into the resilience test rather than maintained as a further requirement, with the consequential arbitrary inequity between offices.

6.9 In §§ 2.6 and 2.7 of the current paper we have put forward proposals for refinement of the working rule to make allowance for adverse circumstances. There is clearly an argument which says that when conditions are particularly 'favourable', as for example they appeared to be in early 1972 and mid 1987 (see Appendix 3), a stronger test should be required. For the reasons already

adumbrated, however, we do not see a need for greater severity as a matter of course, and would be uneasy at any formal requirement for a stronger test at certain times. We prefer to believe that the actuary would have due regard to economic conditions when he determines whether the standard test is adequate for any particular valuation.

6.10 Similar reasoning can be applied to the issue of 'coherence' which we addressed briefly in § 2.8 of our earlier paper (see Appendix 2). Common sense tells us that, as with any other requirement that has the effect of incorporating a margin, it is quite inappropriate to impute any sort of iteration into the resilience test. If substantial changes in values are known to have taken place just after the valuation date, this fact could hardly be overlooked by the actuary in determining his reserves. Changes before the valuation date, as occurred in October 1987, would also have no effect on the need for, or strength of, a resilience test unless the post-change conditions were considered to be exceptional: in this, by definition unusual, event it might well become necessary to modify valuation requirements in a context wider than merely resilience. We will not attempt to define 'exceptional' except by suggesting that conditions were *not* exceptional at the end of 1987, but *were* at the end of 1974!

6.11 A topic of considerable importance, to which we are conscious we have done less than full justice, is the treatment of with-profits business. As indicated in §§ 4.15–4.17 the application of resilience tests is inextricably bound up with the interpretation of 'reasonable expectations' and the assessment of bonuses that would be paid in changed conditions. The topic is one that is currently the subject of major debate and much research within the profession, and we make no apology for failing to add significantly to the published material. Suffice it to say that the resilience test should follow, rather than lead, professional thinking on this issue, and at a practical level we would not envisage much difficulty in modifying or refining the test to incorporate the results of that wider research.

6.12 Finally we turn to the issue of consequential action. The questions were succinctly expressed, in the form of examples, by Roger Corley in his Presidential Address on 24 October 1988[6]. He asked, 'If the market shifts in such a way as to remove 90% of a particular life office's mismatching reserve, and there is no reason to expect a reversal, what mismatching reserve should that office then be required to maintain?', and 'If an early warning bell sounds, what action is required of the Appointed Actuary?'. We are clearly here considering, not the exceptional conditions affecting all offices referred to in § 6.10, but difficulties for an individual company which might correspond to level (ii) of the three situations described in § 1.15 of Sir Edward Johnston's November 1988 paper[7]. The outline of remedial action (though not related specifically to resilience issues) described in that paper will repay careful study. It could hardly be appropriate for a failure to meet the mismatching test *in itself* to lead to a section 11 Order, for surely the purpose of the reserve is to give time for corrective action to be taken, not to cripple companies unnecessarily. It clearly *would* be appropriate,

if the hypothetical company in Roger Corley's first question could no longer support the normal mismatching reserve, for the DTI and the GAD to seek a clear and formal plan from the company's management to attempt to rectify things over a reasonably short timescale. There are indeed major issues here, of great importance to the profession, and we support the call for a central group to consider the questions fully.

6.13 In conclusion, we would return to the central topic of this paper and reiterate the over-riding principle that the working rule is only a tool which the actuary may find helpful in using his professional judgement in relation to the situation of his own office. The GAD has indicated that it does not regard tests based solely on the working rule as necessarily sufficient. That neatly illustrates the fact that the actuary's own judgment is of paramount importance.

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APPENDIX 1

MEMORANDUM TO APPOINTED ACTUARIES FROM THE GOVERNMENT ACTUARY

VALUATION RETURNS IN RELATION TO SOLVENCY MARGINS

1. It is apparent from my Department's scrutiny of companies' 1984 returns that many actuaries have not appreciated the full impact of the changes in the Accounts and Statements Regulations which came into force in March 1984 to give effect to the solvency margin requirements. Many companies have received letters drawing attention to aspects of their 1984 returns which do not appear to meet the new requirements, and the DTI with GAD is considering these on a company by company basis. Many of the points which are causing difficulty are in fact mentioned in the guidance notes on the preparation of annual returns issued by DTI in September 1984. My purpose in writing to you, in common with all other Appointed Actuaries to U.K. authorised companies, is to draw your attention to these guidance notes and also to explain rather more fully the background to and the nature of the changes in the regulations. I hope that any misunderstandings can be cleared up in time for the preparation of the next set of returns, which for most companies will be as at 31 December 1985.
2. The problems seem to arise from the interaction of several factors:
   (i) The solvency margin requirement itself which means that a clear distinction must be drawn between the actuary's reserves and any free reserves in the life fund available for solvency margin.
   (ii) The market value basis laid down for the valuation of assets. The balance sheet and statement of solvency in the Accounts and Statements Regulations are constructed around this concept.
   (iii) Many companies prefer to maintain their life assurance funds at book value, rather than writing the fund up or down to market value each year. It is not intended to whittle away this facility, but there is no doubt that it adds to the complications.
3. The valuation regulations require actuarial reserves to be calculated on a prudent basis. Regulation 55 covers mismatching reserves, which ensure that the company can continue to maintain reserves meeting the minimum criteria in the face of changing investment conditions.
4. Although, in Schedule 4, an actuary may set his reserves in the context of the book value of the life assurance fund, for the purposes of the balance sheet and the statement of solvency (Forms 9, 10 and 14) the reserves have to be set in the context of the assets broadly at market value, as required by the asset valuation regulations. In other words the Schedule 4 valuation has to be justifiable by reference to market values, or additional reserves will need to be set up. In concept there are two sets of mathematical reserves, relating to book and market values respectively. Only the excess over the

total 'market' reserves, which have to be sufficient to cover all foreseeable liabilities including contingencies arising from mismatching, can be counted towards the solvency margin. In practice the main elements of a 'book' valuation basis, such as interest and mortality, are likely to be appropriate for both valuations, but additional provision may be needed for, e.g. mismatching or capital gains tax liabilities, in order to move from a 'book' to a 'market' basis. If any of these items have been set against the margin between market and book values of assets, it is necessary to know how much of this margin has been so used, as only the remainder can count towards the solvency margin. This addition to the Schedule 4 mathematical reserves has to be mentioned in the Actuary's Certificate and shown in a note to Form 14.

5. Thus, in order that GAD can examine valuations in the usual way, the nature and extent of the provision for mismatching and CGT liabilities needs to be stated in the Fourth Schedule. Only then can a view be taken about the cover for the solvency margin shown in the returns. This is the background to paragraphs 7.7.6 - 7.7.7 and 12.6 - 12.8 of the DTI guidance notes.
6. Neither the valuation regulations nor the Institute and Faculty guidance notes lay down a specific basis for the calculation of mismatching reserves, so this is left to the professional judgement of the actuary. GAD's function is to advise the DTI how each company stands having regard to the DTI's responsibilities under the Act. While GAD applies its professional judgement in formulating such advice, we need some rule against which to assess the adequacy of mismatching reserves. Obviously this becomes more crucial the smaller is the excess of free assets over the required solvency margin, but it would be untenable for DTI to operate the regulations on the basis that specific mismatching reserves need to be set up only where the cover for the solvency margin is low, but that stronger companies need not bother and may thus overstate the cover for their solvency margins.
7. In general it is GAD's longstanding practice to formulate its own internal working rules after looking at the way in which established companies have treated the question, which thus needs to be set out in their Fourth Schedules, and after considering any Institute, Faculty or other papers on the subject and discussions thereon.
8. As regards mismatching reserves, the present working rule has regard to current investment conditions and to the tempo and scale of past changes. The present rule was stated at the Birmingham Convention; very briefly we would compare the company's reserves with the ability to meet the requirements of the Regulations (other than Regulation 55) given an immediate rise or fall of 3% in the rate of interest and fall of 25% in equity prices.
9. Naturally companies should also look at their mismatching provisions on the basis of cash flow matching, over a wide range of investment conditions, but this would be in the context of a gross premium valuation rather than

the net premium valuation required by the regulations. These tests need not be fully described in the Fourth Schedule as a matter of routine, the amount of information to be shown would depend on their significance for the company concerned.

10. The essential point, however, is that Fourth Schedule returns will in future need to give greater detail as to the manner of assessment of mismatching reserves and provision for Capital Gains Tax.
11. Before the valuation regulations and guidance notes were written, there were extensive discussions in the Joint Actuarial Working Party comprising representatives of DTI, GAD and the Institute and Faculty. It is now intended to reconvene the Group to consider problems arising. This note is not intended to pre-empt the Joint Working Party in any way. I am writing to you now because it seems necessary to clarify as soon as possible what we will be looking for in the forthcoming returns. I hope this will be helpful.

13 November 1985

APPENDIX 2

EXTRACT FROM 'PROPOSALS FOR THE STATUTORY BASIS OF VALUATION OF THE LIABILITIES OF LINKED LONG-TERM INSURANCE BUSINESS'

2.6 The rise or fall in gilt yields of 3% is unambiguous, since the dividend flows on a gilt are guaranteed. The meaning of a 25% fall in value for equities and properties is less clear: should one assume a rise in yields, a fall in earnings, or some combination of the two? At the end of TPN2 it is indicated that a rise in yields may be assumed when applying the current test, the earnings being unaffected. However, as a basis for the later development of mismatching reserves for linked business, it is helpful to consider equity price falls in a little more detail.

2.7 *Yield and Earnings Effects*

2.7.1 The discussion in this paragraph is based on the simple model of Price = Earnings/Yield (where Earnings refers to Dividends or Rents as appropriate) used in the Maturity Guarantees Working Party report. Other, more complex, models have been constructed, but the simple model has already found reasonable acceptance and is sufficient to illustrate the influences involved.

2.7.2 The market yield changes from day to day and can move quickly. However, it is not unreasonable to model the yield as if it has an underlying long-term level around which the actual yield at any point in time fluctuates. The further the actual yield is from the long-term level, the more likely it is to move back towards it. This is the approach adopted by the Maturity Guarantees Working Party, of course, and it accords with practical intuition.

2.7.3 Earnings change more slowly. Over time they have normally shown growth, but can reduce. Once a reduction occurs, it is less likely to be a short-term feature. Indeed a fall in earnings for any individual equity may well be the harbinger of further bad news. Thus, earnings changes are more 'permanent' – there is no 'long-term' level as there may be for yields. Again, this represents the approach adopted by the Maturity Guarantees Working Party.

2.7.4 From these considerations it is clear that a fall in value resulting from a fall in earnings should be regarded as having a longer term effect on asset income and asset values, whereas a fall in value caused by a rise in yield has no effect on asset income. The effect of a yield rise on asset values may or may not be long-term, depending upon where the yield after the change stands relative to the long-term yield level, but whatever the case, the yield rate has risen. Of the two changes, it is immediately clear that the fall in earnings is the more serious problem.

2.7.5 An important corollary to this is that the current -25% mismatching test is at the weak end of its possible range, operating as it does via yield and leaving earnings unchanged. However, in his remarks at the Birmingham Convention Mr C.L. Cannon indicated that more extreme asset movements should also be tested. Giving $\pm 5\%/-40\%$ as an example, he mentioned that at that

stage an actuary might reasonably have recourse to the margins contained in the minimum standards under Regulations 56 to 64 (and make provision for only a modest level of bonuses), whilst for even more extreme changes in conditions the actuary could rely on the explicit solvency margin in addition to margins in the reserves.

2.8 *Coherence*

2.8.1 Another area of some difficulty relates to problems of coherence. Should the test be modified if substantial changes in values have occurred just *before* the valuation date (or are known to have occurred just *after* it)? In testing for resilience to the assumed benchmark changes, must the actuary assume a succession of such changes into the future?

2.8.2 In fact the answer to the second question above, as indicated in paragraph 8 of the Government Actuary's memorandum (Appendix 1) is 'no' – to the relief, no doubt, of actuaries generally. On the more general issue it should perhaps be noted here that the current test is not regarded as a 'scenario test' and it is not intended that it should become so. In other words, it does not represent a hypothesis about future economic events, but is a purely mechanical process for testing that Regulation 55 can be met. Thus, for example, recent movements in value are ignored. Other parameters are set to maintain the same 'severity' of test compared with the situation before the fall. However, as with yield and earnings effects, it may be helpful to consider coherence problems, from a more theoretical standpoint, in a little more detail.

2.8.3 Any mismatching test will, of course, be subject to some coherence problems. The objective should be to leave in the test the coherence risk which is actually present in real life and to reduce to a minimum any which is created artificially by the test.

2.8.4 Providing that the part of the test dealing with the possibility of an earnings fall is of reasonable weight, there should be no artificial coherence problem from this source. That is, if earnings have fallen just prior to the valuation, it is fully correct that the mismatching test in the valuation examine a further fall. As argued above, when earnings go down they are likely to have moved to a lower path more permanently. A further fall is not improbable.

2.8.5 Moving to look at the yield situation, an office's management will presumably monitor matching continuously, via immunization analyses and so on. Significant market movement should trigger readjustments to the matching position in appropriate areas - for example, a gilt portfolio may be restructured to re-base an immunization. To some extent then, the coherence problems may be reduced by timely management action. Nevertheless, where substantial movements occur very close to the valuation date and for asset holdings not driven by guarantee considerations, there will remain the problem of whether a further yield rise is likely and by how much.

2.8.6 One way to deal with this would be to establish a more flexible test in which the yield risk to be examined varies in extent according to the relationship

of the yield on the valuation date with the long-term yield. A table might be used in which the higher the actual yields stand, the lower the additional asset weakening from further yield increase which must be tested. This would require further investigative statistical work, but should be achievable. The initial work could also establish what the long-term yield should be taken to be for equities and properties independently. The long-term yield should also be subject to periodic review. Perhaps every fifth year might be a sufficiently frequent interval for this.

2.9 In concluding this section, we return briefly to the severity of the current working rule. In terms of market fluctuations actually observed, it describes movements which might be expected to occur (over fairly short periods) every decade or so. As such, it is probably perceived by the profession as a reasonable minimum 'external' standard to use in normal circumstances, and one which companies should be able to satisfy without difficulty. Its 'internal' effect is not, of course, equally stringent for all companies, and varies, for example, with the asset mix: for non-linked business the statutory net premium method of valuation can also introduce distortions. It is an open question (which we do not intend to answer here) whether the optimum test *should* be of this order of 'objective' severity, or whether a more stringent test would be desirable.

APPENDIX 3

EQUITY YIELDS (DIVIDENDS)

Sources:
- BZW equity index (end year figures) 1940–65
- FTA All-share (end quarter figures) 1966–88

APPENDIX 4

VALUATION METHODS

1. As mentioned in §2.11, the application of the '7·2% maximum after 3 years' restriction is not wholly consistent with the traditional form of net premium reserve. It is therefore natural to try to find a valuation method which, whilst preserving the essentials of the net premium approach, allows for a rate of interest achievable on future investments which differs from the rate of interest currently being earned.

2. A method of this type which has attracted some interest is known as the 'W_2' method. That is a reserving method suggested by one of the current authors, Mr A.E.M. Fine, which allows for two rates of interest but retains the net premium approach. It first received widespread publicity at a Life Assurance Conference held at Gleneagles Hotel in October 1986 and was subsequently discussed in some detail by Mr S.F. Elliott in his paper[8] presented to the Bristol Actuarial Society in March 1987. This appendix gives a very brief summary of the development of that method for reference purposes. Some brief comments are also given on another suggestion for a suitable valuation method under the regulations.

The W_2 Method

3. Let the traditional net premium reserve, e.g. ${}_tV_{x:\overline{n}|}$, be denoted 'V_1'. Then by use of a premium conversion formula it is easily demonstrable that

$$V_1 A^i_{x+t:\overline{n-t}|} + \left(\frac{i}{1+i}\, V_1 + P^i_{x:\overline{n}|}\right) \ddot{a}^i_{x+t:\overline{n-t}|} \;=\; A^i_{x+t:\overline{n-t}|}$$

If instead of assuming a level interest rate, i, it is assumed that the current earnings rate is g and the future reinvestment rate will be i, then the analogous reserve to V_1, known as V_2, is given by

$$V_2 A^i_{x+t:\overline{n-t}|} + \left(\frac{g}{1+i}\, V_2 + P^i_{x:\overline{n}|}\right) \ddot{a}^i_{x+t:\overline{n-t}|} \;=\; A^i_{x+t:\overline{n-t}|}$$

Equating the above two expressions for $A^i_{x+t:\overline{n-t}|}$ gives the more usual expression for V_2.

$$V_2 \;=\; \frac{V_1}{1 + \dfrac{g-i}{1+i}\, \ddot{a}^i_{x+t:\overline{n-t}|}}$$

4. The V_2 method has been examined elsewhere in the literature and has been found to give reserves which do not have satisfactory characteristics in all circumstances. Such deficiencies have led to the development of the W_2 method.

5. The essential difference between the 'V' and 'W' methods is that, in the latter, the net premium itself is made dependent upon both i and g. A 'W_1'

reserve analogous to V_1 is given by the formula

$$W_1 = A^{i}_{x+t:\overline{n-t}|} - P^{(ig)}_{x:\overline{n}|}\, \ddot{a}^{i}_{x+t:\overline{n-t}|}$$

where $P^{(ig)}_{x:\overline{n}|}$ is a net premium calculated on a rate of interest, i', which is some function of i and g. A simple weighting which has regard to the outstanding term such as

$$i' = \frac{tg + (n-t)i}{n}$$

is normally used. W_1 reserves do not have particularly satisfactory properties and are simply an intermediate step.

6. W_2 reserves are developed from W_1 reserves by a formula analogous to that given in §3 of this appendix for V_2. That is

$$W_2 = \frac{W_1}{1 + \frac{g-i}{1+i}\, \ddot{a}^{i}_{x+t:\overline{n-t}|}}$$

A Further Method

7. A different conceptual approach has been suggested by Mr C.S.S. Lyon and is also recorded here for reference. His approach starts from the basic valuation formula (ignoring mortality):

$$V = v^{t} S\,(1 - f_t)$$

where f_t represents the proportion of S which can be secured by future premiums. A 'prudent' valuation method will ensure that f_t is not overstated. In the traditional net premium method $f_t = P_{\overline{n}|}/P_{\overline{r}|}$ where both numerator and denominator are calculated at the valuation rate of interest.

8. The presentation reveals a fundamental problem of the net premium method in that f_t increases as the interest rate falls whereas in a gross premium valuation (or a net premium valuation where the net premium has had to be restricted by reference to the office premium) the opposite is true. That has led to the suggestion that an appropriate valuation method may be to calculate f_t using a formula of the above type at a uniform high rate of interest. One would then discount $S(1 - f_t)$ at a rate of interest which had regard to the current yield on assets at market value and allowed for the effect of future realisations and reinvestments.

9. If it is appropriate to assume that the current yield on the present reserve will be maintained for the duration of the policy, then the method, designated here as 'U_2', bears the same relationship to a hypothetical U_1 as V_2 and W_2 bear to V_1 and W_1 respectively. Thus

$$U_1 = A^{i}_{x+t:\overline{n-t}|}\left[1 - \frac{P^{h}_{x:\overline{n}|}}{P^{h}_{x+t:\overline{n-t}|}}\right]$$

and

$$U_2 = \frac{U_1}{1 + \frac{g - i}{1 + i} \ddot{a}^{i}_{x+t:\overline{n-t}|}}$$

where h is a suitably large, independently determined rate of interest.

10. It is evident that U_2 is larger than V_2 if $h > i$. It can be shown that U_2 is larger than W_2 when $g < h$ and smaller if $g > h$; they are approximately equal when $g = h$. For a constant h, U_2 reserves are therefore more sensitive to changes in g – and therefore to changes in asset values – than are W_2 reserves. Some disadvantages of the method are apparent, particularly regarding who should be responsible for setting the value of h. The U_2 approach does also move some way away from the pure net premium valuation. However, at the time of writing the approach has not been fully explored.

11. A further specific development of the W_2 approach, which has been used in the investigation in Section 4, is described in Appendix 6.

APPENDIX 5

ILLUSTRATIONS OF THE METHOD DESCRIBED IN SECTION 3

Tables 5.1–5.3: *Illustration ignoring contingent tax on capital gains*

Table 5.1. *Apportionment of current assets equal to liabilities*

	Gilts	Land	Equities	TOTALS	Average Yield	92·5%
Yield	11·2%	5·1%	3·6%			
Life assurance fund	267,000	445,000	103,500	815,500	6·91%	6·39%
General annuity fund	3,120	5,200	1,560	9,880	6·79%	6·28%
Pension business fund	28,800	48,000	14,400	91,200	6·79%	6·28%
TOTALS apportioned to liabilities	298,920	498,200	119,460	916,580	6·89%	6·38%
Mismatching reserve derived from Table 5.2	-	-	60,923	60,923		
	298,920	498,200	180,383	977,503		

Table 5.2. *Revised values of apportioned assets and liabilities in the '−25%, +3%' test condition*

		Gilts	Land	Equities	TOTALS
Yield		14·2%	6·8%	4·8%	
Life assurance fund	Assets	226,950	333,750	77,625	638,325
	Liabilities	226,500	377,500	87,801	691,801
		+ 450	− 43,750	− 10,176	− 53,476
General annuity fund	Assets	2,652	3,900	1,170	7,722
	Liabilities	2,490	4,150	1,245	7,885
		+ 162	− 250	− 75	− 163
Pension business fund	Assets	24,480	36,000	10,800	71,280
	Liabilities	20,000	33,333	10,000	63,333
		+ 4,480	+ 2,667	+ 800	+ 7,947
TOTALS	Assets	254,082	373,650	89,595	717,327
	Liabilities	248,990	414,983	99,046	763,019
		+ 5,092	− 41,333	− 9,451	− 45,692

Assuming the mismatching reserve is held as additional equities, its amount is 45,692/0·75 = 60,923

Table 5.3. *Apportionment of assets (including mismatching reserve) equal to liabilities in the test condition*

	Gilts	Land	Equities	TOTALS	Average Yield	92.5%
Yield	14·2%	6·8%	4·8%			
Life assurance fund	226,950	333,750	131,101	691,801	8·85%	8·18%
General annuity fund	2,652	3,900	1,333	7,885	8·95%	8·28%
Pension business fund	24,480	36,000	2,853	63,333	9·57%	8·85%
TOTALS	254,082	373,650	135,287	763,019	8·91%	8·24%

Tables 5.4–5.6. *Illustration including contingent tax on capital gains as a liability*

Table 5.4. *Apportionment of current assets equal to liabilities*

	Gilts	Land	Equities	TOTALS	Average Yield	92.5%
Yield	11·2%	5·1%	3·6%			
Life assurance fund	267,000	445,000	103,500	815,500	6·91%	6·39%
General annuity fund	3,120	5,200	1,560	9,880	6·79%	6·28%
Pension business fund	28,800	48,000	14,400	91,200	6·79%	6·28%
Contingent CGT			10,000	10,000		
TOTALS apportioned to liabilities	298,920	498,200	129,460	926,580	6·89%	6·38%
Mismatching reserve derived from Table 5.5	–	–	52,256	52,256		
	298,920	498,200	181,716	978,836		

Table 5.5. *Revised values of apportioned assets and liabilities in the '−25%, +3%' test condition*

		Gilts	Land	Equities	TOTALS
Yield		14·2%	6·8%	4·8%	
Life assurance fund	Assets	226,950	333,750	77,625	638,325
	Liabilities	226,500	377,500	87,801	691,801
		+450	−43,750	−10,176	−53,476
General annuity fund	Assets	2,652	3,900	1,170	7,722
	Liabilities	2,490	4,150	1,245	7,885
		+162	−250	−75	−163
Pension business fund	Assets	24,480	36,000	10,800	71,280
	Liabilities	20,000	33,333	10,000	63,333
		+4,480	+2,667	+800	+7,947
Contingent CGT	Assets			7,500	7,500
	Liabilities			1,000	1,000
				+6,500	+6,500
TOTALS	Assets	254,082	373,650	97,095	724,827
	Liabilities	248,990	414,983	100,046	764,019
		+5,092	−41,333	−2,951	−39,192

Assuming the mismatching reserve is held as additional equities, its amount is 39,192/0·75 = 52,256, in addition to the amount held in respect of contingent tax on capital gains in the current conditions.

Table 5.6. *Apportionment of assets (including mismatching reserve) equal to liabilities in the test condition*

	Gilts	Land	Equities	TOTALS	Average yield	92·5%
Yield	14·2%	6·8%	4·8%			
Life assurance fund	226,950	333,750	131,101	691,801	8·85%	8·18%
General annuity fund	2,652	3,900	1,333	7,885	8·95%	8·28%
Pension business fund	24,480	36,000	2,853	63,333	9·57%	8·85%
Contingent CGT			1,000	1,000		
	254,082	373,650	136,287	764,019	8·91%	8·24%

Note: In Tables 5.4 and 5.6 the assets representing contingent CGT have been excluded from the calculation of the average yield shown against 'totals'.

Table 5.7. *Possible Categories of Liabilities*

Life Assurance Fund - Non Participating:-
- Whole Life
- Endowment
- Single premium bonds
- Temporary assurances

Life Assurance Fund - Participating:-
- Whole Life
- Endowment (10 years)
- Endowment (longer terms)

General Annuity Fund - Non Participating:-
- Deferred Annuities
- Immediate Annuities

General Annuity Fund - Participating:-
- Deposit Administration
- Deferred Annuities
- Immediate Annuities

Pension Business Fund - Non Participating:-
- Group Life Assurance
- Individual Life Assurance
- Annual Premium Deferred Annuities
- Single Premium Deferred Annuities
- Immediate Annuities

Pension Business Fund - Participating:-
- Group Deposit Administration
- Individual Deposit Administration
- Annual Premium Deferred Annuities
- Single Premium Deferred Annuities
- Immediate Annuities

Capital Redemption Business

Permanent Health Insurance

Additional Reserves calculated on an aggregate basis (e.g. AIDS reserve, general contingency reserves).

Current Liabilities

Contingent Capital Gains Tax Liability

Note: The actual details of categories will depend on the individual circumstances of an office, including which types of business form a significant part of the portfolio, and whether different valuation bases apply to significant sections of some categories.

Table 5.8. *Possible Categories of Assets*

A suitable starting point for consideration is the analysis required for Forms 45 and 46 of the DTI Returns.

This would give (with a little rearranging):-

Fixed interest securities issued or guaranteed by any government or public authority:-
- Redeemable, split by unexpired term
- Irredeemable

Other fixed interest securities

Variable interest securities (excluding equity shares) issued or guaranteed by any government or public authority:-
- Capital value or interest determined by an index of prices
- Other

Land

Equity shares

Debts fully secured on land:-
- Due in more than 12 months
- Due in 12 months or less

All other assets:-
- Producing income
- Not producing income

Note: The amount of detail, particularly the number of fixed interest categories, will be varied according to what is needed and to avoid unnecessary detail.

APPENDIX 6

MODIFIED VALUATION METHODS USED FOR EXAMPLES IN SECTION 4

1. Appendix 4 gives a brief description of the V_2 method and its derivatives. This appendix describes the derivation of a further method used in the work described in Section 4.

2. The Regulations allow for all sums invested or reinvested within 3 years of the valuation date to obtain current yields, but for any subsequent payments to be invested only at the valuation rate of interest, subject to the 7·2% restriction. Since the W_2 method involves adjusting net premiums and reserves to take account of the current yield on assets, it does not seem practicable to allow the '3 year reinvestment rule' to be incorporated in addition. Accordingly no account has been taken of it in the calculation of reserves described below.

3. A further problem arises when the assets under consideration have a shorter outstanding term than the policy being valued. A modification has been suggested by Mr A.E.M. Fine which takes credit for V earning g only until the asset matures at which time V is reinvested to earn i, the valuation rate of interest. In the W_2' formula,

$$P^{i}_{x:\overline{n}|}\,\ddot{a}^{i}_{x+t:\overline{n-t}|}$$

would be replaced by

$$P^{i}_{x:\overline{n}|}\,\ddot{a}^{i}_{x+t:\overline{m-t}|} + P^{i}_{x:\overline{n}|}\,{}_{(m-t)|}\ddot{a}^{i}_{x+t:\overline{n-m}|}$$

where m is the original asset term and $m < n$.

4. For ease of calculation, this refinement can be considered as a means of bringing W_2 back closer to V_1 if the asset term is less than that of the liability and so, for the endowment, the following approximation can be justified:-

$${}_{m,t}W^{(i,g)}_{3\,x:\overline{n}|} = \frac{(\ddot{a}^{i}_{x+t:\overline{m-t}|} \times W_2)+({}_{(m-t)|}\ddot{a}^{i}_{x+t:\overline{n-m}|} \times V_1)}{\ddot{a}^{i}_{x+t:\overline{n-t}|}}$$

This reserve is designated here as 'W_3'.

5. For term assurances and other contracts with a fixed option or termination date, the above method works adequately but for whole life assurances, an alternative is required. Instead of i' tracking from i to g over the fixed term, it is assumed that the linear interpolation between W_2 and V_1 is based on the expired duration and the future expectation of life. This modification is simple to apply in practice and the formula for i' is as follows:

$$i'_t = \frac{gt + e_{x+t}\,i}{t + e_{x+t}}$$

6. These methods may be applied to valuing immediate annuities by taking account of the fact that under such contracts no reinvestment of income is

required. It is assumed that the current yield g continues to be earned on the current asset holding until that asset is redeemed after n years; thereafter a yield of i is assumed. Thus,

$$\ddot{a}'_x = \ddot{a}^g_{x:\overline{n}|} + \frac{1}{(1+g)^n} \frac{l_{x+n}}{l_x} \ddot{a}^i_{x+n}$$

In the context of immediate annuities only, this may be considered to be an extension of the '3 year rule' described in §2 of this appendix with the running yield being maintained until redemption rather than for only 3 years.

7. Zillmer adjustments can be incorporated in W_3 net premiums in a similar way as with V_1 net premiums. The Zillmer adjustment is restricted to 3·5% of the capital sum payable under the contract, or the actual expense allowance less tax within the office premium, whichever is less. A further restriction which bites hardest for without profits contracts and term assurances is that the net premium valued must not exceed the office premium (less a suitable allowance for expenses).

8. Assessing the effect of these limits requires specification of scales of office premiums and their expense content. For permanent contracts, expenses have been taken to be 3·5% of the office premium per year of term subject to a maximum of 25 years (35 for whole-life). For temporary assurances, the allowance is 15% per annum subject to a maximum of 10 years counting. Tax relief has been assumed at 35% in the life fund. The following table shows the office premium rates per mille together with the Zillmer adjustments (expressed as percentages of the sum assured or cash option) based on the above formula for both the with and without profits contracts.

		Without profits rate per mille £	With profits rate per mille £	With profits Zillmer %	Without profits Zillmer %
Whole-life	male 30	8·34	22·66	2·0	·75
Whole-life	male 50	22·57	43.17	3·5	1·75
10 year endowment	male 50	83·12	109·60	2·5	2·00
25 year endowment	male 35	24·00	43.70	2·5	1·25
10 year temporary	male 50	7·50	n/a	–	·70
25 year temporary	male 35	3·10	n/a	–	·30
Deferred annuity	25 years	n/a	n/a	3·5	–

9. The effect of using the office premium for without profits contracts is that the initial reserve V_0 (the reserve immediately before payment of the first premium) which would otherwise equal minus 3·5% of the sum assured (or such lower percentage as is allowed by consideration of the expense content of the office premiums) becomes positive and substantial. The following table illustrates the effect for a 25 year without profits endowment assurance effected by a male life aged 35 next birthday, with $i = 1{\cdot}80\%$:

	Premium	Initial reserve
Net (with 1·25% Zillmer)	33·25	− 12·50
Restricted net premium	24·00	175·00

The increase in the initial reserve represents almost 8 times the office premium.

10. This feature also affects the outcome of mismatching tests depending on whether either or both interest rates lead to excessive net premiums. For example, consider the same contract 5 years after the outset with equities yielding 3% initially, changing to 4%. This implies an increase in i from 1·80% to 2·41% (i.e. 4·00% × ·65 × ·925).

	Basis A	Basis B
Initial mathematical liability	158	314
Initial solvency margin	9	15
Total liability (= initial asset value)	167	329
Revised mathematical liability	148	257
Revised solvency margin	8	13
Revised total liability	156	270
Revised asset value	125	247
Amount of mismatching reserve	31	23
Mismatching reserve as % of asset value	25%	9%

Basis A assumes an unrestricted net premium with a Zillmer adjustment of 1·25%.
Basis B assumes the net premium is restricted to the office premium.

APPENDIX 7

MISMATCHING RESERVES FOR HYPOTHETICAL ASSET AND LIABILITY COMBINATIONS, AS DESCRIBED IN SECTION 4

Table 7.1. *Summary of Results*

Table 7.1.1. *Required Mismatching Reserve*

Source table 7.2.				1	2	3	4	5	6	7	8	9	10	11	12
				Whole Life Assurance (without profits)						Whole Life Assurance (with profits)					
Asset		Yield		age 30 at outset			age 50 at outset			age 30 at outset			age 50 at outset		
category	term	current	revised	dur'n 5	dur'n 10	dur'n 25	dur'n 5	dur'n 10	dur'n 25	dur'n 5	dur'n 10	dur'n 25	dur'n 5	dur'n 10	dur'n 25
		%	%	%	%	%	%	%	%	%	%	%	%	%	%
Equities		3	4	-5	3	17	10	17	27	9	12	20	20	23	28
Equities		6	8	-46	-21	7	-11	5	22	-7	0	11	11	15	23
Fixed interest	5	7	10	-29	-13	-1	-11	-4	3	-7	-4	-1	0	1	4
Fixed interest	10	7	10	-25	-9	4	-8	0	9	-3	-1	3	5	6	9
Fixed interest	25	7	10	-19	-3	10	-3	6	19	3	4	8	11	13	20
Fixed interest	5	7	4	194	104	30	65	31	3	61	45	21	21	14	1
Fixed interest	10	7	4	172	88	20	53	22	-4	49	35	12	12	5	-6
Fixed interest	25	7	4	135	63	4	32	5	-17	29	16	-3	-3	-9	-19
Fixed interest	5	10	13	8	8	7	6	7	7	7	7	6	7	7	6
Fixed interest	10	10	13	16	13	11	9	10	11	12	10	9	11	10	8
Fixed interest	25	10	13	20	16	13	8	12	18	13	10	9	13	12	15
Fixed interest	5	10	7	40	15	1	12	4	-3	7	5	1	0	-1	-4
Fixed interest	10	10	7	34	9	-3	8	0	-8	4	1	-3	-4	-5	-8
Fixed interest	25	10	7	24	3	-9	3	-6	-16	-3	-4	-8	-10	-10	-17
Deposits		7	10	-40	-29	-18	-28	-21	-11	-25	-25	-20	-18	-16	-10
Deposits		7	4	228	127	45	84	46	15	79	62	35	35	27	13
Deposits		10	13	-9	-11	-12	-16	-12	-7	-15	-16	-15	-12	-13	-9
Deposits		10	7	66	40	22	39	27	12	34	33	25	21	19	12

Table 7.1.2. *Required Mismatching Reserve*

Asset		Yield		Source table 7.2.								
				13	14	15	16	17	18	19	20	21
				Endowment Assurance (without profits)			Endowment Assurance (with profits)			Level Term Assurance		
				10 year age 50 dur'n 5	25 year age 35 dur'n 5	25 year age 35 dur'n 15	10 year age 50 dur'n 5	25 year age 35 dur'n 5	25 year age 35 dur'n 15	10 year age 50 dur'n 5	25 year age 35 dur'n 5	25 year age 35 dur'n 15
category	term	current	revised									
		%	%	%	%	%	%	%	%	%	%	%
Equities		3	4	28	9	25	31	21	27	33	18	28
Equities		6	8	23	-9	19	28	11	21	25	12	24
Fixed interest	5	7	10	5	-4	4	5	0	3	5	-3	4
Fixed interest	10	7	10	13	1	9	14	5	7	13	-1	9
Fixed interest	25	7	10	26	10	21	27	11	19	26	5	21
Fixed interest	5	7	4	2	77	10	-5	19	4	-5	21	1
Fixed interest	10	7	4	-6	64	2	-12	10	-4	-12	12	-7
Fixed interest	25	7	4	-19	41	-12	-24	-5	-17	-24	-3	-20
Fixed interest	5	10	13	8	8	7	6	7	6	4	6	6
Fixed interest	10	10	13	15	13	10	13	11	8	11	13	6
Fixed interest	25	10	13	23	19	18	21	13	15	19	13	13
Fixed interest	5	10	7	-5	4	-4	-6	0	-3	-5	3	-4
Fixed interest	10	10	7	-12	-1	-8	-12	-5	-7	-11	1	-8
Fixed interest	25	10	7	-21	-9	-18	-21	-10	-16	-20	-5	-17
Deposits		7	10	-6	-18	-9	-5	-17	-11	-6	-22	-10
Deposits		7	4	14	97	23	6	33	15	6	35	12
Deposits		10	13	-3	-6	-7	-5	-11	-10	-7	-11	-11
Deposits		10	7	6	22	10	5	20	13	7	28	11

Table 7.1.3. *Required Mismatching Reserve*

Asset		Yield		Source table 7.2.									
				22	23	24	25	26	27	28	29	30	31
				Immediate Annuity (yearly in advance)				Deferred Annuity With Cash Option at age 65 (age 40 at outset)					
								without profits		with profits		with profits	
				male age 60		male age 80		single premium		annual premium		single premium	
category	term	current	revised	level	5% esc	level	5% esc	dur'n 5	dur'n 15	dur'n 5	dur'n 15	dur'n 5	dur'n 15
		%	%	%	%	%	%	%	%	%	%	%	%
Equities		3	4	22	19	28	27	12	22	13	23	12	22
Equities		6	8	16	11	24	22	-4	13	-3	14	-4	13
Fixed interest	5	7	10	-1	-3	3	2	-9	-3	-7	-2	-9	-3
Fixed interest	10	7	10	3	-1	9	8	-7	-1	-4	0	-7	-1
Fixed interest	25	7	10	11	4	21	19	-4	10	2	12	-4	10
Fixed interest	5	7	4	12	22	0	3	52	17	16	12	52	17
Fixed interest	10	7	4	4	12	-7	-5	41	8	7	3	41	8
Fixed interest	25	7	4	-10	-3	-20	-18	22	-7	-7	-11	22	-7
Fixed interest	5	10	13	2	1	4	3	4	3	6	3	4	3
Fixed interest	10	10	13	4	1	9	7	4	1	9	3	5	2
Fixed interest	25	10	13	9	3	16	14	3	9	10	10	3	9
Fixed interest	5	10	7	1	3	-3	-2	10	3	8	2	10	3
Fixed interest	10	10	7	-3	1	-9	-7	8	1	4	0	8	1
Fixed interest	25	10	7	-10	-4	-18	-16	4	-9	-2	10	4	-9
Deposits		7	10	-17	-22	-9	-11	-28	18	-24	-17	-28	-18
Deposits		7	4	25	36	12	14	70	30	29	25	70	30
Deposits		10	13	-15	-19	-9	-10	-19	-15	-14	-13	-19	-15
Deposits		10	7	21	29	10	13	39	22	31	20	39	22

Table 7.1.4. *Required Mismatching Reserve*

		Source table 7.2.		32	33	34	35	36
					CGT Reserve for Unrealised Equity Life Fund Appreciation			
				Fixed Liability	30% appreciation		100% appreciation	
Asset		Yield			change in current asset value of equities			
category	term	current	revised		-25%	nil	-25%	nil
		%	%	%	%	%	%	%
Equities		3	4	33	-100	N/A	-33	N/A
Equities		6	8	33	-100	N/A	-33	N/A
Fixed interest	5	7	10	12	-100	12	-44	12
Fixed interest	10	7	10	20	-100	20	-40	20
Fixed interest	25	7	10	34	-100	34	-33	34
Fixed interest	5	7	4	-10	-100	-10	-55	-10
Fixed interest	10	7	4	-17	-100	-17	-58	-17
Fixed interest	25	7	4	-28	-100	-28	-64	-28
Fixed interest	5	10	13	11	-100	11	-44	11
Fixed interest	10	10	13	19	-100	19	-41	19
Fixed interest	25	10	13	27	-100	27	-37	27
Fixed interest	5	10	7	-11	-100	-11	-55	-11
Fixed interest	10	10	7	-17	-100	-17	-59	-17
Fixed interest	25	10	7	-25	-100	-25	-63	-25
Deposits		7	10	0	-100	0	-50	0
Deposits		7	4	0	-100	0	-50	0
Deposits		10	13	0	-100	0	-50	0
Deposits		10	7	0	-100	0	-50	0

Tables 7.2. *Details of Calculations*

Non profit Whole-life Assurance Male 30 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.1 Tax rate 35% Solvency 4% Solvency .003 Zillmer .75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	263	12.73	276	276	207	187	9.92	197	-9.88	-4.78%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	88	6.26	94	94	71	34	4.26	38	-32.43	-45.88%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	55	5.04	60	60	54	34	4.26	38	-15.36	-28.65%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	55	5.04	60	60	50	33	4.22	37	-12.61	-25.31%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	55	5.04	60	60	45	32	4.18	36	-8.62	-19.24%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	55	5.04	60	60	67	187	9.92	197	129.99	194.21%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	55	5.04	60	60	72	187	9.92	197	124.62	172.37%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	55	5.04	60	60	84	187	9.92	197	113.18	135.16%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	34	4.26	38	38	34	33	4.22	37	2.89	8.43%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	33	4.22	37	37	31	32	4.18	36	4.86	15.50%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	32	4.18	36	36	28	30	4.11	34	5.68	19.97%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	34	4.26	38	38	43	55	5.04	60	17.20	40.15%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	33	4.22	37	37	45	55	5.04	60	15.19	33.88%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	32	4.18	36	36	48	55	5.04	60	11.55	23.82%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	55	5.04	60	60	60	32	4.18	36	-23.85	-39.73%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	55	5.04	60	60	60	187	9.92	197	136.88	228.01%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	32	4.18	36	36	36	29	4.07	33	-3.11	-8.60%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	32	4.18	36	36	36	55	5.04	60	23.85	65.92%

Non profit Whole-life Assurance Male 30 next at entry Duration 10 years Sum assured £ 1,000

Table 7.2.2 Tax rate 35% Solvency 4% Solvency .003 Zillmer .75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	327	15.10	342	342	257	251	12.29	263	6.71	2.62%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	146	8.40	154	154	116	85	6.15	91	-24.66	-21.29%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	109	7.03	116	116	104	84	6.11	90	-13.52	-13.05%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	109	7.03	116	116	96	82	6.03	88	-8.28	-8.60%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	109	7.03	116	116	87	78	5.89	84	-2.71	-3.13%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	109	7.03	116	116	129	251	12.29	263	133.93	103.53%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	109	7.03	116	116	140	251	12.29	263	123.55	88.42%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	109	7.03	116	116	162	251	12.29	263	101.44	62.68%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	84	6.11	90	90	81	81	6.00	87	6.15	7.60%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	82	6.03	88	88	74	78	5.89	84	9.79	13.21%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	78	5.89	84	84	66	71	5.63	77	10.71	16.25%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	84	6.11	90	90	101	109	7.03	116	15.14	15.01%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	82	6.03	88	88	106	109	7.03	116	9.98	9.41%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	78	5.89	84	84	112	109	7.03	116	3.63	3.23%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	109	7.03	116	116	116	77	5.85	83	-33.18	-28.60%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	109	7.03	116	116	116	251	12.29	263	147.25	126.91%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	77	5.85	83	83	83	68	5.52	74	-9.33	-11.27%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	77	5.85	83	83	83	109	7.03	116	33.18	40.05%

Non profit Whole-life Assurance Male 30 next at entry Duration 25 years Sum assured £ 1,000

Table 7.2.3 Tax rate 35% Solvency 4% Solvency .003 Zillmer .75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	539	22.94	562	562	421	471	20.43	491	69.97	16.60%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	366	16.54	383	383	287	292	13.80	306	18.90	6.59%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	324	14.99	339	339	303	285	13.55	299	-4.21	-1.39%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	324	14.99	339	339	281	278	13.29	291	9.90	3.52%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	324	14.99	339	339	253	266	12.84	279	25.86	10.22%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	324	14.99	339	339	378	471	20.43	491	113.50	30.03%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	324	14.99	339	339	408	471	20.43	491	83.19	20.38%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	324	14.99	339	339	473	471	20.43	491	18.60	3.93%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	285	13.55	299	299	268	274	13.14	287	19.27	7.19%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	278	13.29	291	291	245	259	12.58	272	26.41	10.77%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	266	12.84	279	279	219	236	11.73	248	28.63	13.07%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	285	13.55	299	299	334	324	14.99	339	4.71	1.41%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	278	13.29	291	291	351	324	14.99	339	-11.93	-3.40%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	266	12.84	279	279	374	324	14.99	339	-34.65	-9.27%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	324	14.99	339	339	339	265	12.81	278	-61.18	-18.05%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	324	14.99	339	339	339	471	20.43	491	152.44	44.97%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	265	12.81	278	278	278	232	11.58	244	-34.22	-12.32%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	265	12.81	278	278	278	324	14.99	339	61.18	22.02%

Non profit Whole-life Assurance Male 50 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.4 Tax rate 35% Solvency 4% Solvency .003 Zillmer 1.75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	283	13.47	296	296	222	232	11.58	244	21.23	9.55%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	155	8.74	164	164	123	102	6.77	109	-14.03	-11.42%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	125	7.63	133	133	118	99	6.66	106	-12.79	-10.79%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	125	7.63	133	133	110	95	6.52	102	-8.57	-7.79%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	125	7.63	133	133	99	90	6.33	96	-2.65	-2.67%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	125	7.63	133	133	148	232	11.58	244	95.73	64.74%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	125	7.63	133	133	160	232	11.58	244	83.87	52.51%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	125	7.63	133	133	185	232	11.58	244	58.59	31.67%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	99	6.66	106	106	95	94	6.48	100	5.67	5.98%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	95	6.52	102	102	85	87	6.22	93	7.78	9.10%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	90	6.33	96	96	76	76	5.81	82	6.12	8.09%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	99	6.66	106	106	118	125	7.63	133	14.32	12.10%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	95	6.52	102	102	122	125	7.63	133	10.33	8.44%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	90	6.33	96	96	129	125	7.63	133	3.55	2.75%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	125	7.63	133	133	133	89	6.29	95	-37.33	-28.15%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	125	7.63	133	133	133	232	11.58	244	110.96	83.66%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	89	6.29	95	95	95	74	5.74	80	-15.56	-16.32%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	89	6.29	95	95	95	125	7.63	133	37.33	39.18%

Non profit Whole-life Assurance Male 50 next at entry Duration 10 years Sum assured £ 1,000

Table 7.2.5 Tax rate 35% Solvency 4% Solvency .003 Zillmer 1.75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	392	17.50	410	410	307	344	15.73	360	52.60	17.13%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	265	12.81	278	278	208	208	10.70	219	10.34	4.96%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	234	11.66	246	246	219	201	10.44	211	-7.96	-3.63%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	234	11.66	246	246	204	194	10.18	204	.27	.13%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	234	11.66	246	246	183	185	9.85	195	11.51	6.28%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	234	11.66	246	246	274	344	15.73	360	85.85	31.35%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	234	11.66	246	246	296	344	15.73	360	63.89	21.59%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	234	11.66	246	246	343	344	15.73	360	17.08	4.98%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	201	10.44	211	211	190	193	10.14	203	13.43	7.08%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	194	10.18	204	204	172	180	9.66	190	17.81	10.36%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	185	9.85	195	195	153	163	9.03	172	18.93	12.36%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	201	10.44	211	211	237	234	11.66	246	8.91	3.77%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	194	10.18	204	204	246	234	11.66	246	-.32	-.13%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	185	9.85	195	195	261	234	11.66	246	-15.43	-5.91%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	234	11.66	246	246	246	184	9.81	194	-51.85	-21.11%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	234	11.66	246	246	246	344	15.73	360	114.07	46.43%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	184	9.81	194	194	194	162	8.99	171	-22.81	-11.77%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	184	9.81	194	194	194	234	11.66	246	51.85	26.75%

Non profit Whole-life Assurance Male 50 next at entry Duration 25 years Sum assured £ 1,000

Table 7.2.6 Tax rate 35% Solvency 4% Solvency .003 Zillmer 1.75%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	680	28.16	708	708	531	646	26.90	673	141.78	26.69%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	587	24.72	612	612	459	536	22.83	559	100.04	21.81%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	560	23.72	584	584	521	517	22.13	539	17.80	3.42%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	560	23.72	584	584	485	505	21.69	527	42.16	8.70%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	560	23.72	584	584	436	499	21.46	520	84.84	19.47%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	560	23.72	584	584	651	646	26.90	673	22.14	3.40%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	560	23.72	584	584	703	646	26.90	673	-30.06	-4.28%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	560	23.72	584	584	814	646	26.90	673	-141.29	-17.35%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	517	22.13	539	539	484	496	21.35	517	33.62	6.95%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	505	21.69	527	527	443	473	20.50	494	50.20	11.33%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	499	21.46	520	520	409	462	20.09	482	73.14	17.88%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	517	22.13	539	539	604	560	23.72	584	-19.94	-3.30%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	505	21.69	527	527	635	560	23.72	584	-50.79	-8.00%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	499	21.46	520	520	697	560	23.72	584	-113.68	-16.30%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	560	23.72	584	584	584	499	21.46	520	-63.26	-10.84%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	560	23.72	584	584	584	646	26.90	673	89.18	15.28%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	499	21.46	520	520	520	462	20.09	482	-38.37	-7.37%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	499	21.46	520	520	520	560	23.72	584	63.26	12.15%

With profit Whole-life Assurance Male 30 next at entry Duration 5 years Sum assured £ 1,000 Bonus £ 276

Table 7.2.7 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.0%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	195	11.04	206	206	155	159	9.71	169	14.18	9.18%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	106	7.75	114	114	85	73	6.53	80	-5.78	-6.78%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	87	7.05	94	94	84	72	6.49	78	-5.50	-6.55%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	87	7.05	94	94	78	69	6.38	75	-2.68	-3.44%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	87	7.05	94	94	70	66	6.27	72	2.08	2.97%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	87	7.05	94	94	105	159	9.71	169	63.86	60.91%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	87	7.05	94	94	113	159	9.71	169	55.45	48.96%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	87	7.05	94	94	131	159	9.71	169	37.53	28.61%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	72	6.49	78	78	70	69	6.38	75	4.95	7.03%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	69	6.38	75	75	63	65	6.23	71	7.79	12.27%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	66	6.27	72	72	57	58	5.97	64	7.19	12.66%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	72	6.49	78	78	88	87	7.05	94	6.16	7.01%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	69	6.38	75	75	91	87	7.05	94	3.23	3.56%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	66	6.27	72	72	97	87	7.05	94	-2.79	-2.88%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	87	7.05	94	94	94	64	6.20	70	-23.85	-25.36%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	87	7.05	94	94	94	159	9.71	169	74.66	79.39%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	64	6.20	70	70	70	54	5.83	60	-10.37	-14.77%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	64	6.20	70	70	70	87	7.05	94	23.85	33.98%

With profit Whole-life Assurance Male 30 next at entry Duration 10 years Sum assured £ 1,000 Bonus £ 628

Table 7.2.8 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.0%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	482	22.72	505	505	379	405	19.87	425	46.33	12.24%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	291	15.65	307	307	230	216	12.88	229	-1.11	-.48%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	248	14.06	262	262	234	211	12.69	224	-10.36	-4.42%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	248	14.06	262	262	218	204	12.43	216	-1.09	-.50%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	248	14.06	262	262	196	191	11.95	203	7.38	3.77%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	248	14.06	262	262	292	405	19.87	425	132.71	45.42%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	248	14.06	262	262	316	405	19.87	425	109.27	34.62%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	248	14.06	262	262	366	405	19.87	425	59.34	16.23%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	211	12.69	224	224	201	203	12.40	215	14.69	7.32%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	204	12.43	216	216	182	189	11.88	201	18.71	10.27%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	191	11.95	203	203	159	165	10.99	176	16.52	10.36%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	211	12.69	224	224	250	248	14.06	262	11.60	4.63%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	204	12.43	216	216	261	248	14.06	262	1.32	.51%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	191	11.95	203	203	272	248	14.06	262	-9.88	-3.63%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	248	14.06	262	262	262	186	11.77	198	-64.29	-24.53%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	248	14.06	262	262	262	405	19.87	425	162.81	62.13%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	186	11.77	198	198	198	156	10.66	167	-31.11	-15.73%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	186	11.77	198	198	198	248	14.06	262	64.29	32.51%

With profit Whole-life Assurance Male 30 next at entry Duration 25 years Sum assured £ 1,000 Bonus £ 2,386

Table 7.2.9 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.0%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	2,052	86.08	2,138	2,138	1,604	1,840	78.24	1,918	314.68	19.62%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	1,498	65.58	1,564	1,564	1,173	1,241	56.08	1,297	124.39	10.61%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	1,358	60.40	1,418	1,418	1,267	1,202	54.63	1,257	-10.15	-.80%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	1,358	60.40	1,418	1,418	1,177	1,160	53.08	1,213	35.71	3.03%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	1,358	60.40	1,418	1,418	1,059	1,097	50.75	1,148	89.20	8.43%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	1,358	60.40	1,418	1,418	1,581	1,840	78.24	1,918	336.92	21.31%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	1,358	60.40	1,418	1,418	1,708	1,840	78.24	1,918	210.07	12.30%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	1,358	60.40	1,418	1,418	1,978	1,840	78.24	1,918	-60.20	-3.04%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	1,202	54.63	1,257	1,257	1,128	1,146	52.56	1,199	71.04	6.30%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	1,160	53.08	1,213	1,213	1,021	1,061	49.42	1,110	89.40	8.76%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	1,097	50.75	1,148	1,148	902	936	44.79	981	78.94	8.75%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	1,202	54.63	1,257	1,257	1,407	1,358	60.40	1,418	11.37	.81%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	1,160	53.08	1,213	1,213	1,461	1,358	60.40	1,418	-43.03	-2.94%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	1,097	50.75	1,148	1,148	1,538	1,358	60.40	1,418	-119.52	-7.77%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	1,358	60.40	1,418	1,418	1,418	1,088	50.41	1,138	-279.99	-19.74%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	1,358	60.40	1,418	1,418	1,418	1,840	78.24	1,918	499.83	35.24%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	1,088	50.41	1,138	1,138	1,138	918	44.12	962	-176.29	-15.49%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	1,088	50.41	1,138	1,138	1,138	1,358	60.40	1,418	279.99	24.59%

With profit Whole-life Assurance Male 50 next at entry Duration 5 years Sum assured £ 1,000 Bonus £ 276

Table 7.2.10 Tax rate 35% Solvency 4% Solvency .003 Zillmer 3.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	294	14.71	309	309	232	264	13.60	278	46.07	19.90%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	215	11.78	227	227	170	178	10.41	188	18.33	10.77%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	195	11.04	206	206	184	174	10.27	184	.25	.13%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	195	11.04	206	206	171	169	10.08	179	8.05	4.71%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	195	11.04	206	206	154	161	9.79	171	17.02	11.07%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	195	11.04	206	206	230	264	13.60	278	47.89	20.85%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	195	11.04	206	206	248	264	13.60	278	29.46	11.87%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	195	11.04	206	206	287	264	13.60	278	-9.80	-3.41%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	174	10.27	184	184	165	167	10.01	177	11.67	7.06%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	169	10.08	179	179	151	157	9.64	167	15.91	10.55%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	161	9.79	171	171	134	142	9.08	151	16.89	12.58%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	174	10.27	184	184	206	195	11.04	206	-.28	-.13%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	169	10.08	179	179	216	195	11.04	206	-9.70	-4.50%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	161	9.79	171	171	229	195	11.04	206	-22.80	-9.96%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	195	11.04	206	206	206	160	9.75	170	-36.30	-17.62%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	195	11.04	206	206	206	264	13.60	278	71.55	34.73%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	160	9.75	170	170	170	140	9.01	149	-20.74	-12.22%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	160	9.75	170	170	170	195	11.04	206	36.30	21.38%

With profit Whole-life Assurance Male 50 next at entry Duration 10 years Sum assured £ 1,000 Bonus £ 628

Table 7.2.11 Tax rate 35% Solvency 4% Solvency .003 Zillmer 3.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	703	30.90	734	734	550	647	28.82	676	125.40	22.78%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	551	25.27	576	576	432	475	22.46	497	65.26	15.10%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	510	23.75	534	534	477	461	21.94	483	5.24	1.31%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	510	23.75	534	534	443	447	21.42	468	25.37	5.73%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	510	23.75	534	534	398	429	20.76	450	51.42	12.91%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	510	23.75	534	534	595	647	28.82	676	80.76	13.57%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	510	23.75	534	534	643	647	28.82	676	33.03	5.14%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	510	23.75	534	534	744	647	28.82	676	-68.67	-9.22%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	461	21.94	483	483	433	441	21.20	462	28.88	6.66%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	447	21.42	468	468	394	412	20.13	432	37.87	9.60%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	429	20.76	450	450	353	376	18.80	395	41.40	11.71%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	461	21.94	483	483	541	510	23.75	534	-6.99	-1.29%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	447	21.42	468	468	564	510	23.75	534	-30.57	-5.42%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	421	20.46	441	441	592	510	23.75	534	-57.78	-9.77%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	510	23.75	534	534	534	428	20.72	449	-85.03	-15.93%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	510	23.75	534	534	534	647	28.82	676	142.07	26.62%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	428	20.72	449	449	449	373	18.69	392	-57.04	-12.71%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	428	20.72	449	449	449	510	23.75	534	85.03	18.95%

With profit Whole-life Assurance Male 50 next at entry Duration 25 years Sum assured £ 1,000 Bonus £ 2,386

Table 7.2.12 Tax rate 35% Solvency 4% Solvency .003 Zillmer 3.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	2,661	108.62	2,770	2,770	2,077	2,549	104.47	2,653	576.26	27.74%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	2,350	97.11	2,447	2,447	1,835	2,175	90.63	2,266	430.30	23.45%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	2,260	93.78	2,354	2,354	2,102	2,097	87.75	2,185	82.57	3.93%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	2,260	93.78	2,354	2,354	1,954	2,049	85.97	2,135	181.19	9.27%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	2,260	93.78	2,354	2,354	1,757	2,024	85.05	2,109	352.43	20.06%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	2,260	93.78	2,354	2,354	2,624	2,549	104.47	2,653	29.34	1.12%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	2,260	93.78	2,354	2,354	2,835	2,549	104.47	2,653	-181.15	-6.39%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	2,260	93.78	2,354	2,354	3,283	2,549	104.47	2,653	-629.65	-19.18%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	2,097	87.75	2,185	2,185	1,960	1,988	83.71	2,072	111.44	5.68%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	2,049	85.97	2,135	2,135	1,797	1,855	78.79	1,934	136.84	7.62%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	2,024	85.05	2,109	2,109	1,657	1,832	77.94	1,910	252.75	15.25%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	2,097	87.75	2,185	2,185	2,446	2,260	93.78	2,354	-92.45	-3.78%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	2,049	85.97	2,135	2,135	2,572	2,260	93.78	2,354	-218.28	-8.49%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	2,024	85.05	2,109	2,109	2,826	2,260	93.78	2,354	-472.24	-16.71%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	2,260	93.78	2,354	2,354	2,354	2,024	85.05	2,109	-244.73	-10.40%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	2,260	93.78	2,354	2,354	2,354	2,549	104.47	2,653	299.69	12.73%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	2,024	85.05	2,109	2,109	2,109	1,832	77.94	1,910	-199.10	-9.44%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	2,024	85.05	2,109	2,109	2,109	2,260	93.78	2,354	244.73	11.60%

Non profit 10 year Endowment Male 50 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.13 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.0%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	523	22.35	545	545	409	501	21.54	523	113.52	27.76%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	461	20.06	481	481	361	426	18.76	445	83.97	23.27%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	441	19.32	460	460	411	415	18.36	433	22.24	5.41%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	441	19.32	460	460	382	415	18.36	433	51.26	13.42%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	441	19.32	460	460	344	415	18.36	433	89.82	26.15%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	441	19.32	460	460	513	501	21.54	523	9.35	1.82%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	441	19.32	460	460	554	501	21.54	523	-31.82	-5.74%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	441	19.32	460	460	642	501	21.54	523	-119.53	-18.62%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	415	18.36	433	433	389	401	17.84	419	30.01	7.72%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	415	18.36	433	433	365	401	17.84	419	54.09	14.83%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	415	18.36	433	433	341	401	17.84	419	78.33	23.00%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	415	18.36	433	433	485	441	19.32	460	-24.90	-5.13%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	415	18.36	433	433	522	441	19.32	460	-61.76	-11.83%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	415	18.36	433	433	581	441	19.32	460	-120.36	-20.73%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	441	19.32	460	460	460	415	18.36	433	-26.96	-5.86%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	441	19.32	460	460	460	501	21.54	523	62.22	13.52%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	415	18.36	433	433	433	401	17.84	419	-14.52	-3.35%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	415	18.36	433	433	433	441	19.32	460	26.96	6.22%

Non profit 25 year Endowment Male 35 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.14 Tax rate 35% Solvency 4% Solvency .003 Zillmer 1.25%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	314	14.62	329	329	246	257	12.51	270	23.05	9.35%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	166	9.14	175	175	131	112	7.14	119	-12.21	-9.30%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	129	7.77	137	137	122	110	7.07	117	-5.08	-4.16%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	129	7.77	137	137	114	108	7.00	115	1.47	1.29%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	129	7.77	137	137	102	105	6.89	112	9.81	9.61%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	129	7.77	137	137	152	257	12.51	270	117.03	76.75%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	129	7.77	137	137	165	257	12.51	270	104.80	63.62%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	129	7.77	137	137	191	257	12.51	270	78.73	41.27%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	110	7.07	117	117	105	107	6.96	114	8.92	8.49%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	108	7.00	115	115	97	103	6.81	110	13.02	13.45%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	105	6.89	112	112	88	98	6.63	105	16.71	19.01%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	110	7.07	117	117	131	129	7.77	137	5.69	4.34%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	108	7.00	115	115	139	129	7.77	137	-1.77	-1.27%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	105	6.89	112	112	150	129	7.77	137	-13.15	-8.77%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	129	7.77	137	137	137	105	6.89	112	-24.89	-18.20%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	129	7.77	137	137	137	257	12.51	270	132.74	97.05%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	105	6.89	112	112	112	98	6.63	105	-7.26	-6.49%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	105	6.89	112	112	112	129	7.77	137	24.89	22.24%

Non profit 25 year Endowment Male 35 next at entry Duration 15 years Sum assured £ 1,000

Table 7.2.15 Tax rate 35% Solvency 4% Solvency .003 Zillmer 1.25%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	626	26.16	652	652	489	585	24.65	610	121	24.64%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	511	21.91	533	533	400	455	19.84	475	75	18.80%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	477	20.65	498	498	444	443	19.39	462	18	4.04%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	477	20.65	498	498	413	432	18.98	451	38	9.18%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	477	20.65	498	498	371	432	18.98	451	80	21.43%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	477	20.65	498	498	555	585	24.65	610	55	9.88%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	477	20.65	498	498	599	585	24.65	610	10	1.72%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	477	20.65	498	498	694	585	24.65	610	-84	-12.17%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	443	19.39	462	462	415	426	18.76	445	30	7.20%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	432	18.98	451	451	380	401	17.84	419	39	10.34%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	432	18.98	451	451	354	401	17.84	419	64	18.19%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	443	19.39	462	462	518	477	20.65	498	-20	-3.88%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	432	18.98	451	451	543	477	20.65	498	-46	-8.40%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	432	18.98	451	451	604	477	20.65	498	-107	-17.65%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	477	20.65	498	498	498	432	18.98	451	-47	-9.38%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	477	20.65	498	498	498	585	24.65	610	112	22.51%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	432	18.98	451	451	451	401	17.84	419	-32	-7.13%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	432	18.98	451	451	451	477	20.65	498	47	10.35%

With profit 10 year Endowment Male 50 next at entry Duration 5 years Sum assured £ 1,000 Bonus £ 276

Table 7.2.16 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	712	30.17	742	742	557	698	29.65	728	171.03	30.73%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	669	28.58	698	698	523	643	27.62	671	147.43	28.18%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	656	28.10	684	684	611	622	26.84	649	37.87	6.20%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	656	28.10	684	684	568	622	26.84	649	81.00	14.26%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	656	28.10	684	684	511	622	26.84	649	138.30	27.09%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	656	28.10	684	684	763	698	29.65	728	-35.02	-4.59%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	656	28.10	684	684	824	698	29.65	728	-96.20	-11.68%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	656	28.10	684	684	954	698	29.65	728	-226.55	-23.74%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	622	26.84	649	649	582	593	25.77	619	36.59	6.29%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	622	26.84	649	649	546	593	25.77	619	72.65	13.30%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	622	26.84	649	649	510	593	25.77	619	108.94	21.37%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	622	26.84	649	649	726	656	28.10	684	-42.40	-5.84%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	622	26.84	649	649	782	656	28.10	684	-97.58	-12.48%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	622	26.84	649	649	869	656	28.10	684	-185.32	-21.32%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	656	28.10	684	684	684	622	26.84	649	-35.26	-5.15%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	656	28.10	684	684	684	698	29.65	728	43.55	6.37%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	622	26.84	649	649	649	593	25.77	619	-30.07	-4.63%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	622	26.84	649	649	649	656	28.10	684	35.26	5.43%

With profit 25 year Endowment Male 35 next at entry Duration 5 years Sum assured £ 1,000 Bonus £ 276

Table 7.2.17 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	344	16.56	361	361	270	312	15.37	327	56.96	21.06%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	258	13.37	271	271	204	214	11.75	226	22.22	10.92%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	234	12.49	246	246	220	209	11.56	221	.42	.19%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	234	12.49	246	246	205	203	11.34	214	9.74	4.76%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	234	12.49	246	246	184	194	11.01	205	21.05	11.45%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	234	12.49	246	246	275	312	15.37	327	52.58	19.13%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	234	12.49	246	246	297	312	15.37	327	30.53	10.29%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	234	12.49	246	246	344	312	15.37	327	-16.43	-4.78%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	209	11.56	221	221	198	201	11.27	212	14.37	7.26%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	203	11.34	214	214	180	189	10.82	200	19.42	10.76%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	194	11.01	205	205	161	172	10.19	182	21.11	13.10%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	209	11.56	221	221	247	234	12.49	246	-.47	-.19%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	203	11.34	214	214	258	234	12.49	246	-11.73	-4.54%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	194	11.01	205	205	275	234	12.49	246	-28.21	-10.27%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	234	12.49	246	246	246	194	11.01	205	-41.48	-16.83%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	234	12.49	246	246	246	312	15.37	327	80.89	32.82%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	194	11.01	205	205	205	172	10.19	182	-22.81	-11.13%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	194	11.01	205	205	205	234	12.49	246	41.48	20.23%

With profit 25 year Endowment Male 35 next at entry Duration 15 years Sum assured £ 1,000 Bonus £ 1,079

Table 7.2.18 Tax rate 35% Solvency 4% Solvency .003 Zillmer 2.5%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	1,444	59.67	1,504	1,504	1,128	1,375	57.11	1,432	304	26.99%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	1,249	52.45	1,301	1,301	976	1,137	48.31	1,185	209	21.43%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	1,190	50.27	1,240	1,240	1,108	1,095	46.75	1,142	34	3.07%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	1,190	50.27	1,240	1,240	1,029	1,056	45.31	1,101	72	6.98%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	1,190	50.27	1,240	1,240	926	1,056	45.31	1,101	176	18.98%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	1,190	50.27	1,240	1,240	1,383	1,375	57.11	1,432	49	3.57%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	1,190	50.27	1,240	1,240	1,494	1,375	57.11	1,432	-62	-4.12%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	1,190	50.27	1,240	1,240	1,730	1,375	57.11	1,432	-298	-17.22%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	1,095	46.75	1,142	1,142	1,024	1,038	44.64	1,083	58	5.68%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	1,056	45.31	1,101	1,101	927	955	41.57	997	70	7.51%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	1,056	45.31	1,101	1,101	865	955	41.57	997	131	15.16%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	1,095	46.75	1,142	1,142	1,278	1,190	50.27	1,240	-38	-2.98%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	1,056	45.31	1,101	1,101	1,327	1,190	50.27	1,240	-87	-6.52%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	1,056	45.31	1,101	1,101	1,476	1,190	50.27	1,240	-235	-15.95%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	1,190	50.27	1,240	1,240	1,240	1,056	45.31	1,101	-139	-11.20%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	1,190	50.27	1,240	1,240	1,240	1,375	57.11	1,432	192	15.47%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	1,056	45.31	1,101	1,101	1,101	955	41.57	997	-105	-9.51%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	1,056	45.31	1,101	1,101	1,101	1,190	50.27	1,240	139	12.62%

10 year Term Assurance Male 50 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.19 Tax rate 35% Solvency 4% Solvency .003 Zillmer .7%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	14	3.52	18	18	13	14	3.52	18	4.38	33.33%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	13	3.48	16	16	12	12	3.44	15	3.08	24.94%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	13	3.48	16	16	15	12	3.44	15	.72	4.92%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	13	3.48	16	16	14	12	3.44	15	1.76	12.89%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	13	3.48	16	16	12	12	3.44	15	3.14	25.56%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	13	3.48	16	16	18	14	3.52	18	-.86	-4.66%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	13	3.48	16	16	20	14	3.52	18	-2.33	-11.74%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	13	3.48	16	16	23	14	3.52	18	-5.47	-23.80%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	12	3.44	15	15	14	11	3.41	14	.55	3.97%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	12	3.44	15	15	13	11	3.41	14	1.41	10.83%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	12	3.44	15	15	12	11	3.41	14	2.27	18.72%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	12	3.44	15	15	17	13	3.48	16	-.81	-4.69%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	12	3.44	15	15	19	13	3.48	16	-2.12	-11.42%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	12	3.44	15	15	21	13	3.48	16	-4.21	-20.36%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	13	3.48	16	16	16	12	3.44	15	-1.04	-6.29%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	13	3.48	16	16	16	14	3.52	18	1.04	6.29%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	12	3.44	15	15	15	11	3.41	14	-1.04	-6.71%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	12	3.44	15	15	15	13	3.48	16	1.04	6.71%

25 year Term Assurance Male 35 next at entry Duration 5 years Sum assured £ 1,000

Table 7.2.20 Tax rate 35% Solvency 4% Solvency .003 Zillmer .3%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	32	4.18	36	36	27	28	4.04	32	4.90	18.05%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	22	3.81	26	26	19	18	3.67	22	2.31	11.91%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	20	3.74	24	24	21	17	3.63	21	-.57	-2.70%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	20	3.74	24	24	20	16	3.59	20	-.11	-.58%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	20	3.74	24	24	18	15	3.56	19	.84	4.73%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	20	3.74	24	24	26	28	4.04	32	5.57	21.04%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	20	3.74	24	24	29	28	4.04	32	3.45	12.05%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	20	3.74	24	24	33	28	4.04	32	-1.08	-3.25%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	17	3.63	21	21	19	16	3.59	20	1.08	5.85%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	16	3.59	20	20	16	15	3.56	19	2.06	12.52%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	15	3.56	19	19	15	13	3.48	16	1.90	13.04%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	17	3.63	21	21	23	20	3.74	24	.64	2.78%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	16	3.59	20	20	24	20	3.74	24	.14	.58%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	15	3.56	19	19	25	20	3.74	24	-1.12	-4.52%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	20	3.74	24	24	24	15	3.56	19	-5.19	-21.84%
Deposits		10%	4.68%	5.83%	4%	2.41%	2.41%	20	3.74	24	24	24	28	4.04	32	8.30	34.95%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	15	3.56	19	19	19	13	3.48	16	-2.07	-11.18%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	15	3.56	19	19	19	20	3.74	24	5.19	27.94%

25 year Term Assurance Male 35 next at entry Duration 15 years Sum assured £ 1,000

Table 7.2.21 Tax rate 35% Solvency 4% Solvency .003 Zillmer .3%

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	1.80%	1.80%	4%	2.41%	2.41%	45	4.67	50	50	37	43	4.59	48	10.34	27.77%
Equities		6%	3.61%	3.61%	8%	4.68%	4.81%	40	4.48	44	44	33	37	4.37	41	8.01	24.01%
Fixed interest	5	7%	4.21%	4.21%	10%	4.68%	6.01%	38	4.41	42	42	38	35	4.30	39	1.42	3.75%
Fixed interest	10	7%	4.21%	4.21%	10%	4.68%	6.01%	38	4.41	42	42	35	34	4.26	38	3.06	8.69%
Fixed interest	25	7%	4.21%	4.21%	10%	4.68%	6.01%	38	4.41	42	42	32	34	4.26	38	6.61	20.89%
Fixed interest	5	7%	4.21%	4.21%	4%	2.41%	2.41%	38	4.41	42	42	47	43	4.59	48	.31	.66%
Fixed interest	10	7%	4.21%	4.21%	4%	2.41%	2.41%	38	4.41	42	42	51	43	4.59	48	-3.48	-6.81%
Fixed interest	25	7%	4.21%	4.21%	4%	2.41%	2.41%	38	4.41	42	42	59	43	4.59	48	-11.56	-19.54%
Fixed interest	5	10%	4.68%	6.01%	13%	4.68%	7.82%	35	4.30	39	39	35	33	4.22	37	1.96	5.57%
Fixed interest	10	10%	4.68%	6.01%	13%	4.68%	7.82%	34	4.26	38	38	32	30	4.11	34	1.91	5.93%
Fixed interest	25	10%	4.68%	6.01%	13%	4.68%	7.82%	34	4.26	38	38	30	30	4.11	34	4.05	13.47%
Fixed interest	5	10%	4.68%	6.01%	7%	4.21%	4.21%	35	4.30	39	39	44	38	4.41	42	-1.59	-3.62%
Fixed interest	10	10%	4.68%	6.01%	7%	4.21%	4.21%	34	4.26	38	38	46	38	4.41	42	-3.68	-7.99%
Fixed interest	25	10%	4.68%	6.01%	7%	4.21%	4.21%	34	4.26	38	38	51	38	4.41	42	-8.86	-17.28%
Deposits		7%	4.21%	4.21%	10%	4.68%	6.01%	38	4.41	42	42	42	34	4.26	38	-4.15	-9.78%
Deposits		7%	4.21%	4.21%	4%	2.41%	2.41%	38	4.41	42	42	42	43	4.59	48	5.19	12.23%
Deposits		10%	4.68%	6.01%	13%	4.68%	7.82%	34	4.26	38	38	38	30	4.11	34	-4.15	-10.84%
Deposits		10%	4.68%	6.01%	7%	4.21%	4.21%	34	4.26	38	38	38	38	4.41	42	4.15	10.84%

Immediate Annuity — Male age 60 — Annuity £100 payable yearly in advance

Table 7.2.22 — Solvency 4% — No death strain — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	1,465	58.60	1,524	1,524	1,143	1,346	53.84	1,400	257.14	22.50%
Equities		5%	5.55%	5.55%	8%	7.20%	7.40%	1,153	46.12	1,199	1,199	899	1,005	40.20	1,045	145.86	16.22%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	1,074	42.96	1,117	1,117	998	951	38.04	989	-8.52	-.85%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	1,074	42.96	1,117	1,117	927	916	36.64	953	25.49	2.75%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	1,074	42.96	1,117	1,117	834	891	35.64	927	93.06	11.16%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	1,074	42.96	1,117	1,117	1,245	1,346	53.84	1,400	154.59	12.41%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	1,074	42.96	1,117	1,117	1,345	1,346	53.84	1,400	54.70	4.07%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	1,074	42.96	1,117	1,117	1,558	1,346	53.84	1,400	-158.13	-10.15%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	951	38.04	989	989	887	870	34.80	905	17.38	1.96%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	916	36.64	953	953	802	802	32.08	834	32.27	4.02%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	891	35.64	927	927	728	761	30.44	791	63.33	8.70%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	951	38.04	989	989	1,107	1,074	42.96	1,117	9.54	.86%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	916	36.64	953	953	1,148	1,074	42.96	1,117	-30.71	-2.68%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	891	35.64	927	927	1,242	1,074	42.96	1,117	-124.69	-10.04%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	1,074	42.96	1,117	1,117	1,117	890	35.60	926	-191.36	-17.13%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	1,074	42.96	1,117	1,117	1,117	1,346	53.84	1,400	282.88	25.33%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	890	35.60	926	926	926	760	30.40	790	-135.20	-14.61%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	890	35.60	926	926	926	1,074	42.96	1,117	191.36	20.67%

Immediate Annuity — Male age 60 — Annuity £100 payable yearly in advance escalating at 5%

Table 7.2.23 — Solvency 4% — No death strain — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	2,559	102.36	2,661	2,661	1,996	2,281	91.24	2,372	376.22	18.85%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	1,849	73.96	1,923	1,923	1,442	1,537	61.48	1,598	156.26	10.83%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	1,680	67.20	1,747	1,747	1,560	1,450	58.00	1,508	-52.44	-3.36%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	1,680	67.20	1,747	1,747	1,450	1,379	55.16	1,434	-16.12	-1.11%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	1,680	67.20	1,747	1,747	1,304	1,309	52.36	1,361	57.43	4.40%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	1,680	67.20	1,747	1,747	1,948	2,281	91.24	2,372	424.36	21.79%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	1,680	67.20	1,747	1,747	2,104	2,281	91.24	2,372	268.11	12.74%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	1,680	67.20	1,747	1,747	2,437	2,281	91.24	2,372	-64.81	-2.66%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	1,450	58.00	1,508	1,508	1,353	1,311	52.44	1,363	10.38	.77%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	1,379	55.16	1,434	1,434	1,207	1,173	46.92	1,220	12.82	1.06%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	1,309	52.36	1,361	1,361	1,070	1,061	42.44	1,103	33.74	3.15%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	1,450	58.00	1,508	1,508	1,688	1,680	67.20	1,747	58.71	3.48%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	1,379	55.16	1,434	1,434	1,728	1,680	67.20	1,747	19.43	1.12%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	1,309	52.36	1,361	1,361	1,824	1,680	67.20	1,747	-76.96	-4.22%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	1,680	67.20	1,747	1,747	1,747	1,305	52.20	1,357	-390.00	-22.32%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	1,680	67.20	1,747	1,747	1,747	2,281	91.24	2,372	625.04	35.77%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	1,305	52.20	1,357	1,357	1,357	1,057	42.28	1,099	-257.92	-19.00%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	1,305	52.20	1,357	1,357	1,357	1,680	67.20	1,747	390.00	28.74%

Immediate Annuity — Male age 80 — Annuity £100 payable yearly in advance

Table 7.2.24 — Solvency 4% — No death strain — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	690	27.60	718	718	538	662	26.48	688	150.28	27.92%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	614	24.56	639	639	479	572	22.88	595	115.96	24.21%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	592	23.68	616	616	550	546	21.84	568	17.97	3.27%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	592	23.68	616	616	511	538	21.52	560	48.47	9.48%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	592	23.68	616	616	459	536	21.44	557	97.96	21.32%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	592	23.68	616	616	686	662	26.48	688	2.08	.30%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	592	23.68	616	616	741	662	26.48	688	-52.97	-7.14%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	592	23.68	616	616	859	662	26.48	688	-170.29	-19.83%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	546	21.84	568	568	509	510	20.40	530	20.90	4.10%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	538	21.52	560	560	471	493	19.72	513	41.79	8.87%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	536	21.44	557	557	438	490	19.60	510	71.59	16.34%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	546	21.84	568	568	636	592	23.68	616	-20.12	-3.16%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	538	21.52	560	560	674	592	23.68	616	-58.39	-8.66%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	536	21.44	557	557	747	592	23.68	616	-131.26	-17.57%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	592	23.68	616	616	616	536	21.44	557	-58.24	-9.46%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	592	23.68	616	616	616	662	26.48	688	72.80	11.82%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	536	21.44	557	557	557	490	19.60	510	-47.84	-8.58%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	536	21.44	557	557	557	592	23.68	615	58.24	10.45%

Immediate Annuity — Male age 80 — Annuity £100 payable yearly in advance escalating at 5%

Table 7.2.25 — Solvency 4% — No death strain — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	884	35.36	919	919	690	841	33.64	875	185.12	26.85%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	768	30.72	799	799	599	705	28.20	733	134.16	22.40%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	735	29.40	764	764	683	671	26.84	698	15.15	2.22%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	735	29.40	764	764	634	657	26.28	683	48.78	7.69%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	735	29.40	764	764	570	653	26.12	679	108.65	19.05%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	735	29.40	764	764	852	841	33.64	875	22.44	2.63%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	735	29.40	764	764	921	841	33.64	875	-45.92	-4.99%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	735	29.40	764	764	1,066	841	33.64	875	-191.57	-17.97%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	571	26.84	698	698	626	621	24.84	646	19.70	3.15%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	557	26.28	683	683	575	594	23.76	618	42.66	7.42%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	653	26.12	679	679	534	587	23.48	610	76.86	14.40%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	671	26.84	698	698	781	735	29.40	764	-16.96	-2.17%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	657	26.28	683	683	823	735	29.40	764	-58.77	-7.14%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	653	26.12	679	679	910	735	29.40	764	-145.59	-16.00%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	735	29.40	764	764	764	653	26.12	679	-85.28	-11.16%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	735	29.40	764	764	764	841	33.64	875	110.24	14.42%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	653	26.12	679	679	679	587	23.48	610	-68.64	-10.11%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	653	26.12	679	679	679	735	29.40	764	85.28	12.56%

Deferred Annuity to age 65 | Male 40 next at entry | Duration 5 years | Gt'd Cash Option £ 1,000 | Non-profit

Table 7.2.26 | Solvency 4% | No death strain | Zillmer 3.5% | Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	578	23.12	601	601	451	484	19.36	503	52.52	11.65%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	339	13.56	353	353	264	244	9.76	254	-10.66	-4.03%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	285	11.40	296	296	265	232	9.28	241	-23.44	-8.85%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	285	11.40	296	296	246	220	8.80	229	-17.23	-7.00%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	285	11.40	296	296	221	205	8.20	213	-8.00	-3.62%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	285	11.40	296	296	330	484	19.36	503	172.92	52.33%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	285	11.40	296	296	357	484	19.36	503	146.41	41.02%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	285	11.40	296	296	413	484	19.36	503	89.93	21.75%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	232	9.28	241	241	216	216	8.64	225	8.15	3.76%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	220	8.80	229	229	193	193	7.72	201	8.14	4.23%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	205	8.20	213	213	168	166	6.64	173	5.12	3.05%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	232	9.28	241	241	270	285	11.40	296	26.24	9.71%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	220	8.80	229	229	276	285	11.40	296	20.76	7.53%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	205	8.20	213	213	286	285	11.40	296	10.72	3.75%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	285	11.40	296	296	296	205	8.20	213	-83.20	-28.07%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	285	11.40	296	296	296	484	19.36	503	206.96	69.82%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	205	8.20	213	213	213	166	6.64	173	-40.56	-19.02%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	205	8.20	213	213	213	285	11.40	296	83.20	39.02%

Deferred Annuity to age 65 | Male 40 next at entry | Duration 15 years | Gt'd Cash Option £ 1,000 | Non-profit

Table 7.2.27 | Solvency 4% | No death strain | Zillmer 3.5% | Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	760	30.40	790	790	593	695	27.80	723	130.00	21.93%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	583	23.32	606	606	455	492	19.68	512	56.94	12.52%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	534	21.36	555	555	496	462	18.48	480	-15.52	-3.13%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	534	21.36	555	555	461	437	17.48	454	-6.50	-1.41%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	534	21.36	555	555	414	437	17.48	454	40.02	9.66%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	534	21.36	555	555	619	695	27.80	723	103.65	16.74%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	534	21.36	555	555	669	695	27.80	723	53.99	8.07%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	534	21.36	555	555	775	695	27.80	723	-51.83	-6.69%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	462	18.48	480	480	431	425	17.00	442	10.89	2.53%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	437	17.48	454	454	383	373	14.92	388	5.40	1.41%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	437	17.48	454	454	357	373	14.92	388	30.81	8.63%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	462	18.48	480	480	538	534	21.36	555	17.37	3.23%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	437	17.48	454	454	548	534	21.36	555	7.83	1.43%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	437	17.48	454	454	609	534	21.36	555	-53.62	-8.81%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	534	21.36	555	555	555	437	17.48	454	-100.88	-18.16%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	534	21.36	555	555	555	695	27.80	723	167.44	30.15%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	437	17.48	454	454	454	373	14.92	388	-66.56	-14.65%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	437	17.48	454	454	454	534	21.36	555	100.88	22.20%

Deferred Annuity to age 65 | Male 40 next at entry | Duration 5 years | Gt'd Cash Option £ 1,000 | Bonus £ 403

Table 7.2.28 | Solvency 4% | No death strain | Zillmer 3.5% | Annual Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathematical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathematical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	352	14.08	366	366	275	299	11.96	311	36.40	13.26%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	214	8.56	223	223	167	155	6.20	161	-5.72	-3.43%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	180	7.20	187	187	167	149	5.96	155	-12.23	-7.31%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	180	7.20	187	187	155	143	5.72	149	-6.67	-4.29%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	180	7.20	187	187	140	137	5.48	142	2.77	1.99%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	180	7.20	187	187	209	233	9.32	242	33.62	16.11%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	180	7.20	187	187	225	233	9.32	242	16.88	7.49%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	180	7.20	187	187	261	233	9.32	242	-18.79	-7.20%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	149	5.96	155	155	139	142	5.68	148	8.64	6.22%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	143	5.72	149	149	125	131	5.24	136	11.07	8.84%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	137	5.48	142	142	112	118	4.72	123	10.77	9.62%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	149	5.96	155	155	174	180	7.20	187	13.69	7.89%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	143	5.72	149	149	179	180	7.20	187	8.03	4.48%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	137	5.48	142	142	191	180	7.20	187	-3.72	-1.95%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	180	7.20	187	187	187	137	5.48	142	-44.72	-23.89%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	180	7.20	187	187	187	233	9.32	242	55.12	29.44%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	137	5.48	142	142	142	118	4.72	123	-19.76	-13.87%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	137	5.48	142	142	142	180	7.20	187	44.72	31.39%

Deferred Annuity to age 65 — Male 40 next at entry — Duration 15 years — Gt'd Cash Option £ 1,000 — Bonus £ 1,759

Table 7.2.29 — Solvency 4% — No death strain — Zillmer 3.5% — Annual Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	1,837	73.48	1,910	1,910	1,433	1,695	67.80	1,763	329.94	23.03%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	1,442	57.68	1,500	1,500	1,125	1,233	49.32	1,282	157.56	14.01%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	1,329	53.16	1,382	1,382	1,234	1,165	46.60	1,212	-22.82	-1.85%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	1,329	53.16	1,382	1,382	1,147	1,107	44.28	1,151	4.00	.35%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	1,329	53.16	1,382	1,382	1,031	1,107	44.28	1,151	119.78	11.61%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	1,329	53.16	1,382	1,382	1,541	1,656	66.24	1,722	181.33	11.77%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	1,329	53.16	1,382	1,382	1,665	1,656	66.24	1,722	57.73	3.47%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	1,329	53.16	1,382	1,382	1,928	1,656	66.24	1,722	-205.64	-10.67%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	1,165	46.60	1,212	1,212	1,087	1,079	43.16	1,122	35.05	3.22%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	1,107	44.28	1,151	1,151	969	960	38.40	998	29.40	3.03%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	1,107	44.28	1,151	1,151	905	960	38.40	998	93.77	10.37%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	1,165	46.60	1,212	1,212	1,357	1,329	53.16	1,382	25.55	1.88%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	1,107	44.28	1,151	1,151	1,387	1,329	53.16	1,382	-4.82	-.35%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	1,107	44.28	1,151	1,151	1,543	1,329	53.16	1,382	-160.50	-10.40%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	1,329	53.16	1,382	1,382	1,382	1,107	44.28	1,151	-230.88	-16.70%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	1,329	53.16	1,382	1,382	1,382	1,656	66.24	1,722	340.08	24.60%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	1,107	44.28	1,151	1,151	1,151	960	38.40	998	-152.88	-13.28%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	1,107	44.28	1,151	1,151	1,151	1,329	53.16	1,382	230.88	20.05%

Deferred Annuity to age 65 — Male 40 next at entry — Duration 5 years — Gt'd Cash Option £ 1,000 — Bonus £ 403

Table 7.2.30 — Solvency 4% — No death strain — Zillmer 3.5% — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	810	32.40	842	842	632	678	27.12	705	73.32	11.60%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	476	19.04	495	495	371	342	13.68	356	-15.60	-4.20%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	400	16.00	416	416	372	325	13.00	338	-33.53	-9.03%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	400	16.00	416	416	345	308	12.32	320	-24.99	-7.24%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	400	16.00	416	416	310	288	11.52	300	-10.94	-3.52%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	400	16.00	416	416	464	678	27.12	705	241.34	52.04%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	400	16.00	416	416	501	678	27.12	705	204.14	40.75%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	400	16.00	416	416	580	678	27.12	705	124.87	21.52%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	325	13.00	338	338	303	303	12.12	315	11.85	3.91%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	308	12.32	320	320	270	271	10.84	282	12.23	4.54%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	288	11.52	300	300	235	232	9.28	241	5.93	2.52%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	325	13.00	338	338	378	400	16.00	416	37.55	9.92%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	308	12.32	320	320	386	400	16.00	416	30.10	7.80%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	288	11.52	300	300	401	400	16.00	416	14.66	3.65%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	400	16.00	416	416	416	288	11.52	300	-116.48	-28.00%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	400	16.00	416	416	416	678	27.12	705	289.12	69.50%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	288	11.52	300	300	300	232	9.28	241	-58.24	-19.44%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	288	11.52	300	300	300	400	16.00	416	116.48	38.89%

Deferred Annuity to age 65 — Male 40 next at entry — Duration 15 years — Gt'd Cash Option £ 1,000 — Bonus £ 1,759

Table 7.2.31 — Solvency 4% — No death strain — Zillmer 3.5% — Single Premium

asset category	asset term	current yield	current i	current g	revised yield	revised i	revised g	current mathe-matical reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised mathe-matical reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Equities		3%	2.78%	2.78%	4%	3.70%	3.70%	2,097	83.88	2,181	2,181	1,636	1,919	76.76	1,996	360.10	22.02%
Equities		6%	5.55%	5.55%	8%	7.20%	7.40%	1,608	64.32	1,672	1,672	1,254	1,358	54.32	1,412	158.08	12.60%
Fixed interest	5	7%	6.48%	6.48%	10%	7.20%	9.25%	1,473	58.92	1,532	1,532	1,368	1,276	51.04	1,327	-41.13	-3.01%
Fixed interest	10	7%	6.48%	6.48%	10%	7.20%	9.25%	1,473	58.92	1,532	1,532	1,272	1,205	48.20	1,253	-18.39	-1.45%
Fixed interest	25	7%	6.48%	6.48%	10%	7.20%	9.25%	1,473	58.92	1,532	1,532	1,143	1,205	48.20	1,253	109.94	9.62%
Fixed interest	5	7%	6.48%	6.48%	4%	3.70%	3.70%	1,473	58.92	1,532	1,532	1,708	1,919	76.76	1,996	287.89	16.86%
Fixed interest	10	7%	6.48%	6.48%	4%	3.70%	3.70%	1,473	58.92	1,532	1,532	1,845	1,919	76.76	1,996	150.89	8.18%
Fixed interest	25	7%	6.48%	6.48%	4%	3.70%	3.70%	1,473	58.92	1,532	1,532	2,137	1,919	76.76	1,996	-141.01	-6.60%
Fixed interest	5	10%	7.20%	9.25%	13%	7.20%	12.03%	1,276	51.04	1,327	1,327	1,191	1,174	46.96	1,221	30.27	2.54%
Fixed interest	10	10%	7.20%	9.25%	13%	7.20%	12.03%	1,205	48.20	1,253	1,253	1,055	1,030	41.20	1,071	16.41	1.56%
Fixed interest	25	10%	7.20%	9.25%	13%	7.20%	12.03%	1,205	48.20	1,253	1,253	985	1,030	41.20	1,071	86.49	8.78%
Fixed interest	5	10%	7.20%	9.25%	7%	6.48%	6.48%	1,276	51.04	1,327	1,327	1,486	1,473	58.92	1,532	46.05	3.10%
Fixed interest	10	10%	7.20%	9.25%	7%	6.48%	6.48%	1,205	48.20	1,253	1,253	1,510	1,473	58.92	1,532	22.15	1.47%
Fixed interest	25	10%	7.20%	9.25%	7%	6.48%	6.48%	1,205	48.20	1,253	1,253	1,679	1,473	58.92	1,532	-147.31	-8.77%
Deposits		7%	6.48%	6.48%	10%	7.20%	9.25%	1,473	58.92	1,532	1,532	1,532	1,205	48.20	1,253	-278.72	-18.19%
Deposits		7%	6.48%	6.48%	4%	3.70%	3.70%	1,473	58.92	1,532	1,532	1,532	1,919	76.76	1,996	463.84	30.28%
Deposits		10%	7.20%	9.25%	13%	7.20%	12.03%	1,205	48.20	1,253	1,253	1,253	1,030	41.20	1,071	-182.00	-14.52%
Deposits		10%	7.20%	9.25%	7%	6.48%	6.48%	1,205	48.20	1,253	1,253	1,253	1,473	58.92	1,532	278.72	22.24%

Fixed Liability of £100

Table 7.2.32 Tax rate N/A Solvency 0%

asset category	asset term	current yield	revised yield	current reserve	current solvency margin	current total reserve	current asset value	revised asset value	revised reserve	revised solvency margin	revised total reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Equities		3%	4%	100	0	100	100	75	100	0	100	25.00	33.33%
Equities		6%	8%	100	0	100	100	75	100	0	100	25.00	33.33%
Fixed interest	5	7%	10%	100	0	100	100	89	100	0	100	10.69	11.97%
Fixed interest	10	7%	10%	100	0	100	100	83	100	0	100	16.99	20.47%
Fixed interest	25	7%	10%	100	0	100	100	75	100	0	100	25.37	34.00%
Fixed interest	5	7%	4%	100	0	100	100	111	100	0	100	-11.49	-10.30%
Fixed interest	10	7%	4%	100	0	100	100	120	100	0	100	-20.43	-16.96%
Fixed interest	25	7%	4%	100	0	100	100	139	100	0	100	-39.48	-28.31%
Fixed interest	5	10%	13%	100	0	100	100	90	100	0	100	10.27	11.45%
Fixed interest	10	10%	13%	100	0	100	100	84	100	0	100	15.83	18.81%
Fixed interest	25	10%	13%	100	0	100	100	79	100	0	100	21.42	27.27%
Fixed interest	5	10%	7%	100	0	100	100	112	100	0	100	-11.97	-10.69%
Fixed interest	10	10%	7%	100	0	100	100	120	100	0	100	-20.47	-16.99%
Fixed interest	25	10%	7%	100	0	100	100	134	100	0	100	-34.00	-25.37%
Deposits		7%	10%	100	0	100	100	100	100	0	100	.00	0%
Deposits		7%	4%	100	0	100	100	100	100	0	100	.00	0%
Deposits		10%	13%	100	0	100	100	100	100	0	100	.00	0%
Deposits		10%	7%	100	0	100	100	100	100	0	100	.00	0%

Capital Gains Tax reserve for LAF fund — 30% unrealised appreciation

Table 7.2.33 Tax rate 35% — Solvency 0% — 25% reduction in equity asset

asset category	asset term	current yield	revised yield	equity asset purchase price	equity asset market value	CGT rate for reserve	equity asset value change	current CGT reserve	current asset value	revised asset value	revised CGT reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Equities		3%	4%	1,000	1,300	20%	25%	60	60	45	0	-45.00	-100%
Equities		6%	8%	1,000	1,300	20%	25%	60	60	45	0	-45.00	-100%
Fixed interest	5	7%	10%	1,000	1,300	20%	25%	60	60	54	0	-53.59	-100%
Fixed interest	10	7%	10%	1,000	1,300	20%	25%	60	60	50	0	-49.80	-100%
Fixed interest	25	7%	10%	1,000	1,300	20%	25%	60	60	45	0	-44.78	-100%
Fixed interest	5	7%	4%	1,000	1,300	20%	25%	60	60	67	0	-66.89	-100%
Fixed interest	10	7%	4%	1,000	1,300	20%	25%	60	60	72	0	-72.26	-100%
Fixed interest	25	7%	4%	1,000	1,300	20%	25%	60	60	84	0	-83.69	-100%
Fixed interest	5	10%	13%	1,000	1,300	20%	25%	60	60	54	0	-53.84	-100%
Fixed interest	10	10%	13%	1,000	1,300	20%	25%	60	60	51	0	-50.50	-100%
Fixed interest	25	10%	13%	1,000	1,300	20%	25%	60	60	47	0	-47.15	-100%
Fixed interest	5	10%	7%	1,000	1,300	20%	25%	60	60	67	0	-67.18	-100%
Fixed interest	10	10%	7%	1,000	1,300	20%	25%	60	60	72	0	-72.28	-100%
Fixed interest	25	10%	7%	1,000	1,300	20%	25%	60	60	80	0	-80.40	-100%
Deposits		7%	10%	1,000	1,300	20%	25%	60	60	60	0	-60.00	-100%
Deposits		7%	4%	1,000	1,300	20%	25%	60	60	60	0	-60.00	-100%
Deposits		10%	13%	1,000	1,300	20%	25%	60	60	60	0	-60.00	-100%
Deposits		10%	7%	1,000	1,300	20%	25%	60	60	60	0	-60.00	-100%

(3) after adjustment for indexation allowance

Capital Gains Tax reserve for LAF fund — 30% unrealised appreciation

Table 7.2.34 Tax rate 35% — Solvency 0% — nil reduction in equity asset

asset category	asset term	current yield	revised yield	equity asset purchase price	equity asset market value	CGT rate for reserve	equity asset value change	current CGT reserve	current asset value	revised asset value	revised CGT reserve	amount of mismatch	required mismatch reserve
			(1) (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Equities						not applicable							
Fixed interest	5	7%	10%	1,000	1,300	20%	0%	60	60	54	60	6.41	11.97%
Fixed interest	10	7%	10%	1,000	1,300	20%	0%	60	60	50	60	10.20	20.47%
Fixed interest	25	7%	10%	1,000	1,300	20%	0%	60	60	45	60	15.22	34.00%
Fixed interest	5	7%	4%	1,000	1,300	20%	0%	60	60	67	60	-6.89	-10.30%
Fixed interest	10	7%	4%	1,000	1,300	20%	0%	60	60	72	60	-12.26	-16.96%
Fixed interest	25	7%	4%	1,000	1,300	20%	0%	60	60	84	60	-23.69	-28.31%
Fixed interest	5	10%	13%	1,000	1,300	20%	0%	60	60	54	60	6.16	11.45%
Fixed interest	10	10%	13%	1,000	1,300	20%	0%	60	60	51	60	9.50	18.81%
Fixed interest	25	10%	13%	1,000	1,300	20%	0%	60	60	47	60	12.85	27.27%
Fixed interest	5	10%	7%	1,000	1,300	20%	0%	60	60	67	60	-7.18	-10.69%
Fixed interest	10	10%	7%	1,000	1,300	20%	0%	60	60	72	60	-12.28	-16.99%
Fixed interest	25	10%	7%	1,000	1,300	20%	0%	60	60	80	60	-20.40	-25.37%
Deposits		7%	10%	1,000	1,300	20%	0%	60	60	60	60	.00	0%
Deposits		7%	4%	1,000	1,300	20%	0%	60	60	60	60	.00	0%
Deposits		10%	13%	1,000	1,300	20%	0%	60	60	60	60	.00	0%
Deposits		10%	7%	1,000	1,300	20%	0%	60	60	60	60	.00	0%

(3) after adjustment for indexation allowance

Capital Gains Tax reserve for LAF fund — 100% unrealised appreciation

Table 7.2.35 Tax rate 35% — Solvency 0% — 25% reduction in equity asset

asset category	asset term	current yield	revised yield	equity asset purchase price	equity asset market value	CGT rate for reserve	equity asset value change	current CGT reserve	current asset value	revised asset value	revised CGT reserve	amount of mismatch	required mismatch reserve
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Equities		3%	4%	1,000	2,000	20%	25%	200	200	150	100	-50.00	-33.33%
Equities		6%	8%	1,000	2,000	20%	25%	200	200	150	100	-50.00	-33.33%
Fixed interest	5	7%	10%	1,000	2,000	20%	25%	200	200	179	100	-78.62	-44.02%
Fixed interest	10	7%	10%	1,000	2,000	20%	25%	200	200	166	100	-66.01	-39.76%
Fixed interest	25	7%	10%	1,000	2,000	20%	25%	200	200	149	100	-49.26	-33.00%
Fixed interest	5	7%	4%	1,000	2,000	20%	25%	200	200	223	100	-122.97	-55.15%
Fixed interest	10	7%	4%	1,000	2,000	20%	25%	200	200	241	100	-140.86	-58.48%
Fixed interest	25	7%	4%	1,000	2,000	20%	25%	200	200	279	100	-178.97	-64.15%
Fixed interest	5	10%	13%	1,000	2,000	20%	25%	200	200	179	100	-79.45	-44.27%
Fixed interest	10	10%	13%	1,000	2,000	20%	25%	200	200	168	100	-68.33	-40.59%
Fixed interest	25	10%	13%	1,000	2,000	20%	25%	200	200	157	100	-57.15	-36.37%
Fixed interest	5	10%	7%	1,000	2,000	20%	25%	200	200	224	100	-123.94	-55.34%
Fixed interest	10	10%	7%	1,000	2,000	20%	25%	200	200	241	100	-140.95	-58.50%
Fixed interest	25	10%	7%	1,000	2,000	20%	25%	200	200	268	100	-167.99	-62.69%
Deposits		7%	10%	1,000	2,000	20%	25%	200	200	200	100	-100.00	-50%
Deposits		7%	4%	1,000	2,000	20%	25%	200	200	200	100	-100.00	-50%
Deposits		10%	13%	1,000	2,000	20%	25%	200	200	200	100	-100.00	-50%
Deposits		10%	7%	1,000	2,000	20%	25%	200	200	200	100	-100.00	-50%

(3) after adjustment for indexation allowance

Capital Gains Tax reserve for LAF fund — 100% unrealised appreciation

Table 7.2.36 Tax rate 35% — Solvency 0% — nil reduction in equity asset

asset category	asset term	current yield (1)	revised yield (2)	equity asset purchase price (3)	equity asset market value (4)	CGT rate for reserve (5)	equity asset value change (6)	current CGT reserve (7)	current asset value (8)	revised asset value (9)	revised CGT reserve (10)	amount of mismatch (11)	required mismatch reserve (12)
Equities						not applicable							
Fixed interest	5	7%	10%	1,000	2,000	20%	0%	200	200	179	200	21.38	11.97%
Fixed interest	10	7%	10%	1,000	2,000	20%	0%	200	200	166	200	33.99	20.47%
Fixed interest	25	7%	10%	1,000	2,000	20%	0%	200	200	149	200	50.74	34.00%
Fixed interest	5	7%	4%	1,000	2,000	20%	0%	200	200	223	200	-22.97	-10.30%
Fixed interest	10	7%	4%	1,000	2,000	20%	0%	200	200	241	200	-40.86	-16.96%
Fixed interest	25	7%	4%	1,000	2,000	20%	0%	200	200	279	200	-78.97	-28.31%
Fixed interest	5	10%	13%	1,000	2,000	20%	0%	200	200	179	200	20.55	11.45%
Fixed interest	10	10%	13%	1,000	2,000	20%	0%	200	200	168	200	31.67	18.81%
Fixed interest	25	10%	13%	1,000	2,000	20%	0%	200	200	157	200	42.85	27.27%
Fixed interest	5	10%	7%	1,000	2,000	20%	0%	200	200	224	200	-23.94	-10.69%
Fixed interest	10	10%	7%	1,000	2,000	20%	0%	200	200	241	200	-40.95	-16.99%
Fixed interest	25	10%	7%	1,000	2,000	20%	0%	200	200	268	200	-67.99	-25.37%
Deposits		7%	10%	1,000	2,000	20%	0%	200	200	200	200	.00	0%
Deposits		7%	4%	1,000	2,000	20%	0%	200	200	200	200	.00	0%
Deposits		10%	13%	1,000	2,000	20%	0%	200	200	200	200	.00	0%
Deposits		10%	7%	1,000	2,000	20%	0%	200	200	200	200	.00	0%

(3) after adjustment for indexation allowance

APPENDIX 8

RESULTS OF THE STOCHASTIC INVESTIGATION DESCRIBED IN SECTION 5

Table 8.1. *Endowment Assurance Without Profits – Term 10 Years – Age 50 at entry – Duration 5 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	18.8%	28	5.3%	26	5.6%
Equities		6	8	19.5%	26	5.6%	24	6.7%
Fixed Interest	5	7	10	0.1%	11	0.0%	5	0.0%
Fixed Interest	5	10	13	0.0%	12	0.0%	1	0.0%
Fixed Interest	10	7	10	22.6%	19	0.0%	14	0.0%
Fixed Interest	10	10	13	0.0%	19	0.0%	8	0.0%
Fixed Interest	25	7	10	67.9%	33	0.1%	27	0.6%
Fixed Interest	25	10	13	0.1%	28	0.0%	16	0.0%
Cash		7	4	0.0%	14	0.0%	12	0.0%
Cash		10	7	0.0%	1	0.0%	0	0.0%

Table 8.2. *Endowment Assurance Without Profits – Term 25 years – Age 35 at entry – Duration 5 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	0.5%	8	0.4%	1	0.6%
Equities		6	8	1.9%	11	1.3%	5	1.5%
Fixed Interest	5	7	4	3.3%	63	0.0%	51	0.1%
Fixed Interest	5	10	13	2.4%	12	0.9%	*	*
Fixed Interest	10	7	4	3.5%	49	0.0%	39	0.2%
Fixed Interest	10	10	13	1.2%	19	0.1%	*	*
Fixed Interest	25	7	10	1.9%	28	0.0%	*	*
Fixed Interest	25	10	13	0.0%	28	0.0%	*	*
Cash		7	4	2.4%	83	0.0%	71	0.1%
Cash		10	7	3.4%	5	2.2%	1	2.9%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.3. *Endowment Assurance Without Profits - Term 25 Years - Age 35 at entry - Duration 15 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	12.2%	24	4.3%	22	5.4%
Equities		6	8	11.6%	24	4.0%	20	4.8%
Fixed Interest	5	7	10	4.0%	9	0.1%	*	*
Fixed Interest	5	10	13	0.0%	12	0.0%	*	*
Fixed Interest	10	7	10	3.3%	18	0.0%	5	0.0%
Fixed Interest	10	10	13	0.0%	19	0.0%	*	*
Fixed Interest	25	7	10	43.4%	31	0.0%	17	0.0%
Fixed Interest	25	10	13	0.0%	28	0.0%	1	0.0%
Cash		7	4	0.8%	20	0.0%	18	0.0%
Cash		10	7	1.7%	3	0.4%	1	1.0%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.4. *Whole Life Assurance Without Profits – Age 30 at entry – Duration 5 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	–	0.0%	#	#	*	*
Equities		6	4.8	0.5%	49	0.2%	24	0.3%
Fixed Interest	5	7	4	3.9%	201	0.0%	163	0.0%
Fixed Interest	5	10	13	3.7%	12	2.5%	*	*
Fixed Interest	10	7	4	3.9%	176	0.0%	142	0.0%
Fixed Interest	10	10	13	2.9%	19	1.9%	*	*
Fixed Interest	25	7	4	4.0%	136	0.1%	107	0.1%
Fixed Interest	25	10	13	1.6%	28	0.5%	*	*
Cash		7	4	3.2%	239	0.0%	197	0.0%
Cash		10	7	4.3%	11	3.2%	3	3.3%

The assets required would for both -25% and +25% changes would be less than those required in current conditions even with limitations on the valuation rate of interest.

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.5. *Whole Life Assurance Without Profits – Age 30 at entry – Duration 10 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	0.2%	0	0.1%	*	*
Equities		6	4.8	0.6%	17	0.4%	4	0.6%
Fixed Interest	5	7	4	3.8%	96	0.1%	78	0.1%
Fixed Interest	5	10	13	3.6%	12	2.0%	*	*
Fixed Interest	10	7	4	4.8%	80	0.1%	64	0.1%
Fixed Interest	10	10	13	2.7%	19	0.7%	*	*
Fixed Interest	25	7	4	3.5%	54	0.0%	40	0.2%
Fixed Interest	25	10	13	0.8%	28	0.1%	*	*
Cash		7	4	3.1%	121	0.0%	101	0.0%
Cash		10	7	4.3%	9	2.9%	3	3.6%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.6. *Whole Life Assurance Without Profits - Age 30 at entry - Duration 25 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	3.4%	16	1.8%	11	2.3%
Equities		6	8	3.0%	15	1.4%	8	1.9%
Fixed Interest	5	7	4	5.6%	27	0.0%	21	0.2%
Fixed Interest	5	10	13	2.2%	12	0.1%	*	*
Fixed Interest	10	7	4	6.8%	16	0.2%	11	0.8%
Fixed Interest	10	10	13	0.4%	19	0.0%	*	*
Fixed Interest	25	7	10	1.8%	27	0.0%	2	0.7%
Fixed Interest	25	10	13	0.0%	28	0.0%	*	*
Cash		7	4	2.3%	43	0.0%	37	0.0%
Cash		10	7	4.5%	6	2.0%	2	3.4%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.7. *Whole Life Assurance Without Profits – Age 50 at entry – Duration 5 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	0.5%	8	0.3%	1	0.3%
Equities		6	4.8	0.8%	5	0.8%	*	*
Fixed Interest	5	7	4	4.3%	75	0.0%	63	0.0%
Fixed Interest	5	10	13	5.5%	12	2.6%	*	*
Fixed Interest	10	7	4	5.2%	61	0.0%	50	0.1%
Fixed Interest	10	10	13	3.3%	19	0.8%	*	*
Fixed Interest	25	7	4	3.2%	37	0.0%	28	0.1%
Fixed Interest	25	10	13	0.7%	28	0.0%	*	*
Cash		7	4	3.3%	97	0.0%	84	0.0%
Cash		10	7	7.4%	15	2.5%	1	6.7%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.8. *Whole Life Assurance Without Profits – Age 50 at entry – Duration 10 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	2.4%	16	1.3%	11	1.8%
Equities		6	8	1.9%	7	1.5%	2	2.0%
Fixed Interest	5	7	4	4.9%	34	0.1%	28	0.1%
Fixed Interest	5	10	13	3.1%	12	0.4%	*	*
Fixed Interest	10	7	4	6.0%	23	0.0%	18	0.2%
Fixed Interest	10	10	13	0.9%	19	0.0%	*	*
Fixed Interest	25	7	10	1.6%	24	0.0%	6	0.1%
Fixed Interest	25	10	13	0.0%	28	0.0%	*	*
Cash		7	4	2.5%	51	0.0%	44	0.0%
Cash		10	7	6.0%	9	2.3%	1	5.3%

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.9. *Whole Life Assurance Without Profits – Age 50 at entry – Duration 25 years*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	14.6%	26	3.5%	24	4.0%
Equities		6	8	12.9%	23	3.6%	19	4.4%
Fixed Interest	5	7	10	11.5%	9	0.0%	#	#
Fixed Interest	5	7	4	11.5%	#	#	2	4.2%
Fixed Interest	5	10	13	0.0%	12	0.0%	*	*
Fixed Interest	10	7	10	66.1%	17	0.0%	7	0.0%
Fixed Interest	10	10	13	0.0%	19	0.0%	*	*
Fixed Interest	25	7	10	84.2%	31	0.0%	19	2.3%
Fixed Interest	25	10	13	0.0%	28	0.0%	6	0.0%
Cash		7	4	0.7%	17	0.0%	15	0.0%
Cash		10	7	2.8%	3	0.6%	1	2.3%

Note that with limitations on valuation rates of interest it is the +3% change which is critical whereas without limitations it is the -3% values which apply.

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

Table 8.10. *Portfolio of Whole Life and Endowment Assurances Without Profits*

Asset		Yield per cent		Reserves based on current conditions	Reserves based on revised conditions			
					Normal Reserves		Without yield limits	
Category	Term (Years)	Current	Revised	Probability of ruin	Percentage increase in assets	Probability of ruin	Percentage increase in assets	Probability of ruin
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equities		3	4	10.3%	24	3.2%	21	3.8%
Equities		6	8	10.1%	25	2.4%	21	3.2%
Fixed Interest	5	7	10	5.5%	10	0.1%	#	#
Fixed Interest	5	7	4	5.5%	#	#	3	5.5%
Fixed Interest	5	10	13	0.0%	12	0.0%	*	*
Fixed Interest	10	7	10	13.3%	18	0.0%	7	0.0%
Fixed Interest	10	10	13	0.0%	19	0.0%	*	*
Fixed Interest	25	7	10	75.0%	32	0.0%	20	0.0%
Fixed Interest	25	10	13	0.0%	28	0.0%	6	0.0%
Cash		7	4	0.9%	19	0.0%	17	0.0%
Cash		10	7	1.7%	3	0.4%	1	1.1%

Note that with limitations on valuation rates of interest it is the +3% change which is critical whereas without limitations it is the -3% values which apply.

* The assets required would be less than those required in "current conditions" where the valuation is subject to limitations on the valuation rate of interest.

ABSTRACT OF THE DISCUSSION

Mr S. F. Elliott (opening the discussion): Although the working rule is crude and mechanistic I agree with the authors in § 6.7 that an office should have no difficulty meeting this requirement in normal circumstances. Indeed, an office's approach to the test must be influenced by conditions at the time. Normally it should not need to become submerged in the details of implementation. Occasionally the rule, without modification, may be unduly onerous and the office would be justified in exploring every margin. In extreme conditions the margins in the minimum valuation standard may have to be relaxed in conjunction with a modified working rule. It is in such difficult or near-impossible conditions that the detailed content of this paper will be particularly valuable.

There are a number of references to the question of coherence which I like to think of as: 'What does it all mean?' We test for the effect of a rise, or fall, in interest rates coupled with a revaluation of the liabilities in the changed circumstances, but ignoring any further change. Yet, if such a change in the investment climate actually occurred we would need to test for a further change. We must decide how much to be influenced by any investment changes since the valuation date, or indeed whether to allow for the full effect of any extraordinary event immediately prior to the valuation date. There is then the question of contingent liabilities and the solvency margin. Fortunately, it seems well established that to test for further changes in investment conditions would be inappropriate. However, since we have this mechanistic procedure as a guideline, I think there is a lot to be said for carrying out the procedure as simply and as realistically as possible, at least in normal circumstances. In other words, it should be carried out to show, as far as seems sensible in the circumstances, what the financial position of the office would be if a certain investment change occurred. For example, I was interested to see in § 4.9 that the solvency margin is included in the testing. I have for some time felt this to be logical. I agree that an office does not appear to be required to do so, but I think it helps to reduce the coherence problem. Furthermore, for a typical office I estimate it would increase the mathematical reserves by about 1%—not insignificant, but not very onerous either.

With the hypothecation of assets, the authors note in § 2.3 that there is no necessity to consider their suitability. Yet I would much rather choose an obviously sensible hypothecation. For a well-established mainly with-profits office, it should be straightforward to achieve a simple hypothecation which at the same time gets quite close to the minimum valuation strength which the actuary should contemplate. If gilts are allocated to non-profits business and a mixture of gilts and equities is allocated to with-profits business there is plenty of scope for further sophistication, such as choosing high yielding gilts for immediate annuity business and current assets for some very short-dated liabilities. Specific property and equity holdings could be selected in decreasing order of dividend yield. If the actuary felt so inclined he could exercise some ingenuity in repackaging the liabilities, such as combining immediate and deferred annuities, to the extent that there is still disinvestment, and value both at the full yield, less the $7\frac{1}{2}\%$ margin. In such an exercise the matching rectangle described in the paper is a marvellous tool, to which I, for one, could get quite addicted. However, the actuary is not playing a sort of 'Regulation 55' game: Regulation 54 is still paramount.

Quite apart from the working rule itself there is potentially great difficulty in fixing the absolute minimum reserves under the Regulations in the changed conditions under the test. On this point, perhaps all one can say with certainty is that the minimum reserves under the Regulations are those acceptable to GAD. In this respect there has been a great deal of technical innovation leading to modified net premium formulae. These still languish in alphabetical obscurity, known only by such references as V_2 and W_3. I think they have a great deal of merit, and should be given official blessing, but only used if the actuary really thinks it is necessary in the circumstances. Appendix 7 shows the effect of using W_3 before and after the change in conditions. These results are interesting, but I think it would be a useful practical exercise to examine the ratios of W_3 reserves after the change to normal net premium reserves before the change. Whatever minimum reserves are acceptable to the authorities, however, they must be acceptable to the professional conscience of the actuary. It would be nice to think there would be little difference between these two figures. In practice there may well be.

Perhaps the most difficult area of judgement is the level of change to provide against. The GAD

guidelines, not formally set out in Regulations, are acting as a code of good practice. Despite the slightly woolly nature of this arrangement I fully endorse all sentiments against making any rule a firm one.

In Section 2 the paper explores possible modifications to the working rule. This must be right in principle, although I agree that further research is needed before anything concrete can be put forward with confidence. In the meantime, however, we must be ready to make some amendments if extreme conditions arise, whichever way markets move. Some suggestions are set out in § 2·6. My tentative feeling is that, if the dividend yield was greater than 6% in a time of moderate inflation, then testing for a fall of $12\frac{1}{2}\%$ in equity values would be a little harsh. On the other hand, if the yield was less than 3·4% one should test for a fall greater than 25%. This is assuming one has a well-balanced portfolio.

The paper refers in § 1.9 to C. L. Cannon's remarks at Birmingham in 1985 concerning extreme conditions. It is important for an office to know just what conditions it could withstand both without any relaxation of the Regulations and with some modest concessions. At least in this exercise the actuary can let his ingenuity run riot and explore every margin and subtle interpretation of application of the rule. I think it is also useful to look at the question of resilience another way by bringing the total assets into account and seeing what adverse change could be suffered whilst still being able to set up reserves under the Regulations, with the exception of Regulation 55. If a sufficient future profits implicit item can be justified, the solvency margin, for this exercise, could be largely ignored. Again, one could test for the effect of relaxing the $7\frac{1}{2}\%$ margin and 7·2% maximum, although I would not be surprised if many offices could withstand a fall of the order of double the guidelines in current conditions without having to do this.

Although I advocate a simple approach to implementing the rule, it may be better, though much more difficult in practice, to express the resilience of one's basis in terms of a probability of ruin. In doing so we must remember that this still depends on certain assumptions. In this respect the results of Section 5 are encouraging, but, despite the comments in § 5.19, I think it would be most interesting to see test results against different working rules, as well as using different assumptions in the stochastic model.

I generally support the Working Party in the comments in § 2.17, and feel that there should be no difference in treatment between equities and properties. Assuming an office has a reasonably well-balanced portfolio in each case then any perceived difference in volatility is probably not worth taking account of. On the other hand, one cannot ignore the extra volatility caused by gearing and therefore I also agree with § 2.18. Further, it may be appropriate for the actuary to allow for a modest level of switching to more volatile assets. What should one do for linked business? To allow for wholesale switching into the most volatile specialist fund available would be going a little too far, but it could be difficult to decide what is reasonable.

In the authors' earlier paper there was much discussion concerning inflation of maintenance expenses (*J.I.A.* **115,** 555). This is one area where there seems to be a potential problem in applying the principle of even-handedness to which the Working Party referred. Under a gross premium valuation allowance for a direct increase in the rate of inflation of expenses may well not prove so onerous for non-linked business, as the Working Party found when applying the principle to linked business. I can see the case for allowing a relaxation for linked business, but I would not favour this approach for non-linked. Where paid-up business and general expense reserves are involved, a revaluation at higher interest rates should include a higher allowance for inflation. The net premium basis should also be tested for adequacy on this point.

One cannot blame the Working Party for giving only modest attention to the problem of policyholders' reasonable expectations. On this matter I agree with the comments made in § 6.11. The questions posed by §§ 4.16–4.18 are fundamental, but I think they beg a further question: what bonus rate is appropriate in the changed conditions? Further research would be most welcome. In 1985 S. L. Smaller presented a paper to this Institute entitled 'Bonus Declarations after a Fall in Interest Rates' (*J.I.A.* **112,** 163). I think we need another paper called: 'Bonus Declarations after a Fall in Asset Values' or even: 'Bonus Declarations after a Rise or Fall in Interest Rates Coupled with a Fall in Equity Values'. For terminal bonus reserves the procedure seems much more straightforward. Asset

share investigations can reveal the required change in terminal bonus scales to be consistent with a fall in asset values, and hence the appropriate reduction in reserves can be determined.

In recent years, an office's perceived financial strength has been a sensitive issue, and realistically we must expect further growth of understanding to be slow. However, increased financial disclosure will gradually lead to less emphasis on free asset ratios and other crude measures of financial strength and to more emphasis on the philosophy and intentions of the office. In that climate I hope we can better consider levels of reserving and resilience to investment changes as being just part of the presentation of the office's financial position.

Mr A. Spedding: The term mismatching reserve is quite remarkable. It is a misnomer in the sense that a perfectly matched diminishing fund, could still be required to set up a mismatching reserve.

Resilience testing seeks to accord a probability of one to the $(-25\%, \pm 3\%)$ investment situation obtaining at midnight on the day of the valuation. That assumption of a probability of one lies somewhat uneasily with the wording of Regulation 55, which talks about the effects of *possible* future changes. One might ask: why not assume a value of $q = 1$ in the valuation, whenever that occurs? The reserve is based on guidelines which, as the opener has mentioned, were introduced at the 1985 Birmingham Convention. It was only subsequently that the Institute confirmed those guidelines, saying that they were considered to be suitable at that time for the investment conditions then obtaining. The guidelines enter into the actuary's area of professional judgement, and one would have thought that they should have emanated from the Institute.

The reserve is said to flow primarily from Regulation 55. The last expression used in that Regulation is ' the liabilities', not 'the amount of the liabilities'. In some of the earlier sections of the 1981 Regulations there is use of both the expressions 'liabilities' and 'amount of liabilities' in different ways, and indeed a definition of one of them. To my mind, all of this implies 'cash flow' mismatching, and not 'big bang' mismatching.

In the paper there is a detailed examination of how the guidelines work. The Working Party has demonstrated that the working rule is not difficult to operate in practice, but when assessing the logic of the rule, time and time again it has come up against the illogicalities of the net premium valuation method, or as it says in §6.7, the 'artificialities and constraints' of the net premium method. The conclusion that the working rule is as satisfactory as any other simple test should perhaps be considered in relation to another possible conclusion: that is, no simple working rule is likely to be satisfactory, particularly for with-profits business.

The rule has the effect of piling margin upon margin. The reserve produced for a fully matched diminishing with-profits fund would merely exacerbate the tontine effect. The whole margin upon margin philosophy could lead to the actuary persuading the directors that the investment policy should be altered, and that change may not be in the long-term interests of the policyholders. It is important when considering new reserving rules that, at each stage, the total regulatory reserve is compared with the reserve that the actuary actually considers is appropriate at that time.

Professor S. Benjamin: Professor Wilkie's model is being used time and time again in actuarial literature. As far as I know it has never been validated. People are just taking it for granted because it is the only one around. I suggest that if we are going to carry on using that model in actuarial literature, we need a Working Party to examine its validity. I suggest that any such Working Party should start by looking at a paper called, 'Applications of Stochastic Financial Models—a Review' by Arno Kitts, who is a research fellow at the Department of Social Statistics at the University of Southampton. He has some very harsh words to say about the model, and the way in which actuaries have accepted it without looking at it properly.

To look at a mismatching reserve as if it is something static at the end of the year is, of course, no use at all. It does not do the right job. What is required is to look at the problem from the other end. What management needs is a method of controlling its investment strategy at any point of time, and it should be asked to do that according to the sort of mismatching reserve which any particular investment strategy would lead to. Then, at least, they have a chance of looking at how much capital would be allocated to support their intended strategy. In other words, what is required is a dynamic

control with management's agreement based on margins. Those margins could be the fairly simple ones that have been adopted, but I suggest that the limited way in which these have been used so far is conceptually inadequate. If we are going to have control in this way, then we would have to try to define an area, which would be not exact, but which would be a good enough matched position, so that at least management could have some idea of how far away they were from this position.

The Working Party's 'big bang' approach is not going to happen, because we have all agreed that if a company gets into trouble it is going to be run off and not sold off—although the courts may not have accepted this yet. There is not going to be a cash payout. Hence it seems to me that we should be concentrating on cash flow.

Mr H. H. Scurfield: Within my company, of which I am the Appointed Actuary, we find a need for two quite separate valuations: firstly, to ensure that we shall always be able to meet the reasonable and on-going expectations of our policyholders—however we may define that; secondly, to ensure that we always remain statutorily solvent. The first guides the prudent financial development and management of my company. It tells us about our bonus earning power and our capacity to cope with changing financial conditions—our resilience. The second, the statutory valuation, has to be done on different bases and brings a whole new set of constraints. It is regrettable that there is no overlap between the two and, indeed, that they can sometimes point in opposite directions.

Let me illustrate this. The statutory basis, as it currently stands, can produce a situation where an office with a strong positive cash flow both now and for the foreseeable future, is required to set up a mismatching reserve to cope with an *increase* in interest rates, a somewhat unreasonable result. The statutory valuation basis requires a rate of interest no greater than $92\frac{1}{2}\%$ of the yield earned, but using only the running yield on equities and property. Thus, for solvency purposes, it is more attractive to be investing in fixed interest securities than ordinary shares, thereby tending to reduce policyholders' expectations in order to show solvency on what is an unreal basis.

Another area affected by the reduction on yields is immediate annuities. In this case the large initial strain is further exacerbated by the requirement for a solvency margin of 4% of the reserve. This limits the number of offices willing to write this business. The result will be to reduce annuity rates unnecessarily. We know also that the statutory valuation basis contains some nonsenses. For instance the mismatching reserve appears to demand the same reduction from market values even after there has been a large reduction in asset values. Perhaps this is because, as has already been mentioned, we started at the wrong place—with a market value of assets combined with a net premium valuation. We know that actuarially these two do not mix. Equally, we are told by the GAD that the statutory requirements may well change in various extreme circumstances. But how extreme would those be and to what extent would those requirements change? Without an answer to this question it is impossible to plan forward against the statutory requirements. In practice we publish a statutory valuation on one basis and do a valuation on a weaker but unspecified basis in order to calculate a mismatching reserve. Thus it is very difficult at the present time to get a feel for our resilience from our published statutory returns. I suggest it is necessary to review the situation and perhaps reflect better the approach taken to resilience within the life companies themselves.

Within our office, when reporting to the directors on our bonus earning power, we do not concern ourselves at all with market values of assets. We look at the stream of income—cash flow as Professor Benjamin would say—we expect to receive from the assets and the stream of outgo from the liabilities and discount those streams on a realistic basis. Of course we have to make some assumptions, but the most important of these are the rates of increase in dividends and rents. Given a reasonable matching of cash income and outgo the choice of discount rate makes very little difference to the end result.

I am then in a position to advise the directors of the size of the estate after allowing for reasonable expectations of policyholders, and to demonstrate how that estate would be reduced if the dividend and rental growth were lower—or even disappeared. Thus the market value of assets is not even a factor, nor, indeed, is it a starting point. Perhaps that should also be the position in statutory resilience. Another value of that sort of basis is that it paints a realistic and meaningful picture which the non-actuary can readily understand. The directors can see at a glance the effect of the extreme conditions which we are planning against.

I agree with the authors that we need a fundamental reappraisal of the basis used for resilience and that we should ensure that it is coherent with the basis of valuation. Speaking now as Chairman of the Life Assurance Joint Committee, I can say that we will be setting up a further Working Party to look at those issues.

Mr G. G. Newton: With 1992 and Europe growing in importance, and the net premium valuation being about the only thing that the reserving standards of the Twelve have in common, I shall be rather surprised if we do not still have the net premium valuation with us for some years to come.

In § 2.5 I wonder whether the authors are correct in stating that the test needs to be applied at only two points in their plane. The bench marks of a 3% change in interest rates and 25% change in equity prices are intended to represent the limits of the changes which should be considered. If, unusually, within these boundaries there are combinations of changes which give rise to the need for a higher mismatching reserve, then clearly this should be provided for.

The description of a practical method of applying the working rule in § 3.3 refers to the point made in § 2.3 that the application of the rule does not appear to require the notional apportionment of the assets to remain fixed, but that this can be varied at any stage so as to minimize the mismatching reserve. There are important limitations, however, on the extent of such reapportionment. Firstly, the valuation reserves assumed in the changed conditions do have to meet all the requirements of the Regulations except Regulation 55. This requirement, explicit or implicit, could constitute an important restriction on the notional allocation of the assets. Secondly, the actuary must be able to identify, on the one hand, the portfolio of assets covering the mathematical reserves, and, on the other, the surplus assets representing the balance of the fund counting against the solvency margin. By definition the surplus assets could be disbursed without undermining the company's ability to meet its liabilities, and thus clearly cannot be regarded as available for any notional reapportionment in the light of changes in investment conditions. This need for consistency in the identification of the surplus assets has proved to be an important point in practice with liabilities in respect of some unusual contracts.

On the question of the particular parameters for the standard test, the October 1987 Stock Exchange adjustment has stilled the main criticisms in this area and the paper gives broad support for the standard suggested in the Government Actuary's 1987 letter. Clearly the Joint Actuarial Working Party will need to discuss in detail the suggestions in the paper in regard to the bench marks for various types of assets. The case for tapering the requirements for the state of the market seems to be an overwhelming one, and the Working Party put forward some suggestions for halving the $\pm 3\%$ and 25% parameters in certain circumstances. I would be prepared to go further and taper the requirements to nil at a certain point, which would avoid the problem of iteration for the purpose of companies' internal calculations about their position in the event of extreme adverse developments—but all this is for the JAWP.

The Working Party has adopted a practical, empirical approach to the subject and has said little about philosophy. I do not complain about that, but it might be useful to consider briefly the underlying aims and rationale underlying the present working rule. There are a number of separate though related strands which have come together in this test of a company's ability to take changes in investment conditions in its stride. One aspect simply concerns the position of a new policyholder who has just taken out a policy with a company whose returns show it to be in an apparently strong position with reserves meeting the requirements of the Regulations and a well-covered solvency margin. Clearly the industry, the actuarial profession and the supervisory authority would all be brought into disrepute if within a matter of months, as a result of changes in interest rates and falls in asset values of a by-no-means wholly exceptional nature, the policyholder finds himself in a company which no longer possesses a solvency margin and is forced to take crisis measures, even possibly to the extent of having to cease writing further new business altogether. More fundamentally, I do not believe any actuary would quarrel with the thesis that risks resulting from any degree of mismatching need to be covered by additional reserves. Indeed, the exceptional freedom given to United Kingdom companies in regard to investment, including the freedom to mismatch up to 20% by currency, can only be justified—and in practice frequently has to be justified—on the basis of the requirement to

cover mismatching by additional reserves. I doubt if there is any part of the Regulations to which I have more frequently needed to draw attention with foreign visitors, or in discussions in Brussels or elsewhere, than Regulation 55.

The need for mismatching reserves is not really in question. The objections, such as they are, which have been voiced and no doubt will continue to be voiced, relate to a mismatching test which is set, not in the context of cash flow matching, but in that of the statutory net premium reserving standard, including the margins required under the Regulations. The justification would rest in the first instance on the essentially practical point that as solvency has to be demonstrated in terms of the statutory reserving standards it is quite logical for the mismatching test to be applied in that context also. Furthermore, the actuary does not in general have to report on cash flow matching in Schedule 4, and there may well be very different views in regard to the stringency of the assumptions which actuaries might regard as appropriate for such tests. The way in which assets move in relation to liabilities as investment conditions change is a most effective way of bringing to light serious mismatching; and although the resilience test may be a rather crude instrument for this purpose, it is only applied over a much more limited range of investment conditions than the actuary should consider for cash flow matching. Further, there is the fundamental question of the extent to which provision is made for future bonus in the assessment of mismatching reserves for with-profits business. The most significant feature of the net premium valuation is not that it is relatively insensitive to changes in the rate of interest, which it certainly is, but that it makes provision for future bonus for with-profits business.

Considering the view in § 4.18 in regard to the absence of any need to provide for future bonus for the mismatching test, I wonder what the authors mean by the need only to satisfy the statutory minimum basis in this context, particularly for single premium with-profits business. I am not aware that any valuation standard has ever been promulgated in this country which did not require some provision for future bonus, as is implicit in prescribing a net premium basis. Be that as it may, a mismatching test, in the context of a valuation standard which still requires provision for future bonus after the change in investment conditions, constitutes a standard which corresponds to policyholders' reasonable expectations and this feature is a point in favour rather than a drawback of the resilience test.

I would concede that the with-profits policyholder may reasonably be assumed to intend his company to follow a wider ranging investment policy with an inevitable increase in risk, and that bonuses must reflect the results actually achieved. However, if the investment policy followed was such that a by-no-means extreme adverse change in investment conditions led to a position where the assets could no longer support reserves, which continued to make provision for future bonus, this would indicate that the degree of risk being accepted was excessive and not in keeping with policyholders' expectations. However, clearly the extent of the provision for future bonus in the reserves must be consistent with the changed investment conditions as well as with the restrictions under the Valuation Regulations—for example, in regard to credit for future growth in equity dividends. It would be reasonable for the actuary to assume in testing the position of his fund in extreme conditions, that if the provision for future bonus under the net premium valuation becomes excessive when interest rates are very high, the requirement would be modified temporarily by the authorities. But I take the point that Mr Scurfield made about actuaries needing to have some indication of when that point would be reached.

The descriptions of columns (5) and (6) in § 5.15 do not explain why the limit of 7·2% has been applied to the valuation rate of interest as such, rather than just to the element representing the yield on future investment. The general impression I have of the results in Appendix 8 is that in many cases they seem to imply that the reserves are unnecessarily high and that in particular the 7·2% restriction on the rate of interest is unnecessary. This is very much at variance with how our valuation standards strike, at least some, outside observers. A year or two back a senior official from the German supervisory authority spent a month or so with DTI to study our legislation and system of supervision in detail. On the whole he was impressed at the strength and effectiveness of our system, which is so different in approach from that in Germany. The one feature of our Regulations which he regarded as wholly incompatible with a prudent reserving standard was that companies could assume a rate as high as 7·2% for future investment. As he put it, "How do you know that you will not also one day

have inflation close to zero, as we have in Germany, with a level of interest rates to correspond?" Yes indeed, how do we know?

The explanation for the very different picture given by the calculations in Appendix 8 lies, of course, in the underlying model which is generated by an assumption of a mean rate of inflation of 5% and a $3\frac{1}{2}$% real rate of return on gilt-edged investment, although the model does provide for very extensive possible variation about these expected values. The 5% is based on the average experience over a long period in the past which will have included periods of high inflation, periods of low inflation and, indeed, quite long periods of falling prices, with the switch from one to the other often brought about by a shock to the system from some outside cause. It would be unfortunate if our reserving standards could not stand the shock of a move to low rates of inflation. It is worth remembering that yields on gilt-edged securities did not rise to over 7% until the late 1960s. We should also bear in mind that the prospect of some link between sterling and the German mark in a European monetary system in the longer term no longer lies wholly in the realms of fantasy. In the circumstances I would contend that the 7·2% limit in the Valuation Regulations is by no means an over-stringent feature of those Regulations and that, perhaps, any decision to round this figure should be downwards rather than upwards.

Mr N. J. Greenwood: The working rule as it has come to be called, of (−25%, +3%) is acknowledged in the paper as a mechanistic tool and the authors' concluding remarks in § 6.13 show their relegation of it to an actuarial prop in the exercising of professional judgement. Nevertheless, if resilience is to be tested one has to start somewhere and the table in § 4.5 shows that a 25% fall in equity values is broadly consistent with the rise of 3% for fixed interest stocks over 20 years.

I have considered the suddenness of change in modern conditions, because it is the abrupt change in asset values which necessarily allows for no response by the company. For equities in the period May 1972 to the end of 1974, it took 18 months for the *Financial Times* All Share Index to come off 25% from the then all time high. In 1973, starting in any one month, it took 4 to 12 subsequent months to fall a further 25% and from any one month in 1974 this shortened to just 3 to 5 subsequent months—the market then rapidly recovered. In 1987, for equities, in any one month, it took 3 to 6 subsequent months to come off 25%, apart, of course, from the single month prior to 19 October 1987. That dramatic fall is the only sizeable and sudden fall in modern conditions and was set against a background of healthy corporate profitability and rising dividends. Turning to longer term gilts, between January 1973 and February 1974 in any one month, it took 8 to 12 subsequent months for interest rates to rise 3% and in the two-year period September 1977 to September 1979, it took between 15 to 44 subsequent months to rise 3%. Finally, there were two individual months in 1980 after which it took 11 and 14 subsequent months respectively to rise 3%. Against this background I conclude that the working rule in its abrupt nature—the so called 'big bang' approach—is a tough rule.

The probability distribution in § 2.4 brings out the concept of a continuum of the amount of sudden and immediate change from the current position. However, in personal or corporate life, wherever there is a small chance of a big risk occurring, one insures. Insurance companies have self-insured this risk via various methods: by product design and terminal bonus policy; by matching income and investments to liabilities; and by various investment strategies. Insurance of these risks, by other carriers or via the use of options, currently seems out of court either because the Regulations do not permit options to have value, even when they do, or because for the bigger players there would be capacity constraints.

The paper, in §§ 2.3 and 3.10, has restricted its handling of the mismatching reserve in this sense to minimizing it and to franking any release on fixed interest against the equity strain. I would have liked to have seen some input on options to help the supervisors come to recognize them. In § 2.7 the authors refine the 3% rule at the top and bottom of the range. At 15% and over, a 3% increase is 20% or less of that rate. Arguably, interest rate changes at these levels are more cavalier and consequently no change in the rule is considered necessary. One hopes that this is academic. In § 2.15, the methodology for index-linked gilts does not appear to allow for approaching redemptions when volatility must surely reduce. A discounting method, making some assumption over future inflation, would perhaps see to this.

Turning to coherence, I endorse the comments made in § 6.8 about absorbing the $7\frac{1}{2}\%$ of yield into the resilience test. In § 6.4 the higher mismatching reserve referred to for with-profits endowments puts the blame onto the net premium valuation method. This is serious, because it is difficult in the abstract to see the need for any mismatching reserve in the early durations and for the more distant maturity dated with-profits endowments. This, perhaps, leads to the thought that a mismatching reserve need only apply to those liabilities, including deaths and surrenders, that arise in say the next 10 years, longer dated liabilities being taken care of within the $7\frac{1}{2}\%$ and 7·2% limitations. This would go some way to satisfying the proponents of cash-flow matching, and the mismatching reserve for liabilities within 10 years perhaps would be smaller than otherwise. The paper in categorizing liabilities in Table 5.7 does so by product type but not by categories of outstanding term apart from a single curious reference to 10-year endowments presumably by original term.

My earlier remarks indicate that precipitate change is possible but unlikely, and that this is one of the reasons that the mismatching reserve is needed. There will usually be time for a whole battery of action for change on such things as surrender values, terminal bonuses, renewals on recurrent single premium pricing, as well as getting the pricing and products right for future new business. These responses will reduce the financial impact of changing circumstances, thus keeping the full rigours of the working rule for sizeable and sudden changes in asset values.

Mr R. J. Squires: My office, back in the early 1970s, started writing general annuity business, having previously only written linked-life business. We therefore had to consider the question of selecting matching securities. We set up a system to produce cash flows from the liabilities and assets. We then sat down with the investment managers once a quarter and looked at the differences. One of the difficulties we had was finding a single statistic to encapsulate the extent of mismatching. When the working rule was promulgated we had to think how we were going to cope with it. We decided to use an oblique method rather than a direct attack.

First we looked at the asset cash flows discounted at 10%, and the liability cash flows discounted at $9\frac{1}{4}\%$, and expressed the second as a percentage of the first. This was repeated, using 12% and 13% respectively, to see to what extent the percentage had changed. The difference then gave us a measure of the additional reserve that we should have for mismatching. As a side product it has given us our single statistic for measuring the extent of the mismatching, and therefore a basis on which we can indicate to the investment managers the limits within which we would like them to keep.

Mr P. N. Downing: The authors clearly differentiate the different types of mismatching reserves referred to in the paper, although they then maintain the same terminology, apart from a very helpful reference in § 5.9 to the distinction between a mismatch reserve and a misimmunization provision, where I define the additional reserve as the 'misimmunization reserve'!

One of the interesting points of this discussion is that each speaker clearly speaks from the viewpoint of a portfolio of business with which he is familiar. Some concentrate on with-profits policies, some on without-profits, endowment assurances and whole life contracts, and some of us are far more familiar with the risk products of term assurances, risk premium business, and group life contracts. I am particularly interested in the problem posed in considering the immunization and mismatch risk in respect of term assurances. A term assurance contract is one under which there is an excess of premium over risk and expenses at early durations which should be accumulated to meet a shortfall in later durations, as the terminal reserve approaches zero. Clearly, given that we are seeking to match income and outgo, these excess premiums should be invested long to minimize any mismatch. However, it will be appreciated that the longer the duration of the matching investments, the greater the misimmunization reserve that is required to meet the working rule test. I feel this is particularly acute because the net premium valuation reserve is particularly insensitive to the interest assumption for term assurance products.

One of the critical issues before us is to decide which should take precedence: an attempt to avoid a cash flow mismatch or an attempt to avoid the necessity to establish a misimmunization provision. For this particular product it is more appropriate to deliberately mismatch the cash flows in order to minimize the size of the misimmunization reserve. To do otherwise would probably require even more

capital backing for a product which, unless I am badly mistaken, is already priced to give an inadequate return on shareholders' capital.

I was interested in the observations on the investment strategy that Professor Benjamin made and his idea that we should investigate what is a 'good enough' matched position. Maybe that is another way of addressing the term assurance product problem. But I have also tried to define an investment policy which, on the one hand, seeks to protect the company from an excessive mismatched position whilst, on the other, seeks to give the investment managers the necessary degree of flexibility to exercise their investment flair to maximize the benefits of their investment expertise to the company.

One other point which will concern companies without with-profits portfolios, arises from Clause 78 (1) (b) of the current Finance Bill which, if I read it correctly, will seek to disallow the relief of tax on unappropriated surplus carried forward unless it can be specifically demonstrated to be required to support the future expectations of policyholders. This may well give rise to a trend to remove what is currently declared as surplus and covered by surplus assets. There may be a temptation for actuaries to try to establish additional liabilities or reserves to avoid the tax penalty which would otherwise arise. The problem then is whether such liabilities are liabilities to be matched and, if so, how?

I appreciate the authors' comments in § 2.20 on currency mismatching. However terminology may be a hindrance to communication as the essential point here is not misimmunization. If we are looking solely at mismatching on a cash flow basis by currency then it is clearly necessary to distinguish the nature of the overseas currency liabilities against which appropriate assets have to be retained. Clearly, if the portfolio comprises permanent contracts, namely those under which a benefit is certainly payable, it is highly desirable that the backing assets should be not only denominated in the local currency, but probably also localized. This is, I believe, the 80% requirement of Regulation 25(1) to which Mr Newton was referring. However, very different considerations would seem to apply to a term insurance portfolio, particularly in the case of a reinsurer who, in the interpretation of the concept of spreading of risk, may well be spreading mortality risk across currencies, when separate currency backing in minor currencies might be inappropriate. Furthermore, we should note that the net premium valuation technique not only makes implicit allowance for expenses, but also seeks to provide margins of prudence. In such circumstances, I question whether the present test, which seems to be a requirement to cover currency liabilities to at least 95% say, by matching currency assets, is appropriate.

In the case of a term assurance, risk premium or group life portfolio, most of the expenses of a reinsurer in administering the overseas portfolio are very likely to be incurred in sterling irrespective of the currency of the risk. Thus to the extent that there is an element of the net premium liability within the Regulations which is retained against future expenses it would surely be far more appropriate that this was held in sterling rather than in the overseas currency. Furthermore, the prudence margin incorporated in the valuation technique is extremely unlikely to be separately identified with numerous small currency exposures. Given that we are adopting the concept of the spreading of risks, the total of the prudence margins should be regarded as being available to meet the occasional heavy mortality experience in any one particular country. Indeed, it is in the interests of ceding companies that the prudence margins should be held in freely exchangeable strong currencies. In such circumstances, therefore, I am not persuaded that the mismatch should be assessed against the full net premium liability reserved within the valuation.

There is one interesting issue which at times we may overlook, although the authors do refer to it. It is all very well to ask for mismatching and misimmunization reserves, it is then necessary to invest the assets backing those reserves, but I often wonder in what currency, for what term and in what type of asset?

Mr J. Plymen: I have been criticizing the Wilkie model ever since it was invented. It has no economic justification. It is a most extraordinary thing that this model is based entirely on the historic performance over a most peculiar period of economics. At any rate, I agree that actuaries should be criticized for using this model on every possible occasion without justification. I agree with Professor Benjamin that we must have more research into this model, into the effect of inflation and other factors on dividend growth.

Use of the model implies that the investments of the company concerned are nice tidy ones that follow the index. My experience of looking at the finances of some insurance companies is that their investments are not always in that category.

The working rule was devised after the 1974 situation when inflation roared up, equity values dropped, and the yield on gilts went up. That should not necessarily be taken as the model for the future. The fact is that in earlier periods when there has been violent recession in share prices, in 1929 for instance, equity prices fell dramatically and at the same time gilt yields fell. War Loan was converted from 5% to $3\frac{1}{2}\%$. What I call a non-inflationary disaster. It is more likely that a fall in equity values will be associated with a rise in gilt values, that is a fall in gilt yields. The link between the movement of equities and the movement of gilts is problematical.

Mr R. Elven: I have been the deputy actuary of a mutual life insurance society for the last 19 years. In the course of those years I have had reason to look fairly carefully at the statutory valuation systems in Australia, Belgium, Canada, France and South Africa. They have varied between the innocuous and the iniquitous. The innocuous I ignored. For the iniquitous, I changed my product to unitized with-profits, which got rid of the net premium valuation.

I have two problems. I know that it is almost certain that my society will have a net inward cash flow for the next ten years. I know it has not guaranteed its surrender values. My profession tell me I need to set up an extra reserve to guard against the possibility that this cash can be invested at 13%, instead of 10%. My first problem is how do I explain that to my non-executive directors? My next problem comes from the time when these Valuation Regulations were first introduced and I sat in this room and listened to Frank Redington. One of the things he said was that he knew of no occasion when a British life office had been hammered on the basis of the net premium valuation alone. He expressed the hope that if it ever happened, my profession would rise in anger. (*J.I.A.* **102**, 99) Can I rely on my profession?

Mr C. M. Johnson: I agree with Professor Benjamin that cash flow matching is most important and it is this that actuaries and life company management should be controlling. There are dangers in moving away from that view. The problem for regulators, and for the actuaries and management of offices who are not controlling cash flow matching sufficiently closely, is to understand how good or how bad an office's matching position is at any particular time—including those times that happen to be valuation points. Viewed in that light the benchmark test does have some value. As a test it is over-simplistic and can be criticized in detail in many ways. Nevertheless, if we expect that the 'big bang' test reserves will normally be lower the better the cash flow matching position, then the test will serve a purpose, albeit crudely.

Mr G. K. Hazell: It seems to me that the starting point was the Valuation Regulations which referred to the need for mismatching reserves. GAD then developed an internal working rule based on the information available to them. It appears that this internal rule escaped at the Birmingham Convention, and was then embodied in a memorandum from GAD to Appointed Actuaries. Now we have had a Working Party to reflect on resilience testing. It has concluded, in general terms, that the internal working rule is satisfactory. My observation is that I do not disagree with any of these processes; I just wonder whether they should have happened in a different order: that we should have had the profession considering the problems of resilience first, rather than last.

We appear now to have our industry controlled by four arbitrary figures: the $92\frac{1}{2}\%$, which is applied to the average redemption yields, or other yields; the 7·2%, for the reinvestment rate; the ($\pm 3\%$, -25%). I sense that in due course these arbitrary figures are going to be found to be unsatisfactory. They might result in the industry seeking to provide contracts that have less and less insurance content to them. So how will these arbitrary figures ever get changed?

Sir Edward Johnston (closing the discussion): The resilience test originally arose because the Valuation Regulations were linked to market values and market yields; they had to be for reasons which are extraneous to this discussion.

Prices and yields, and the economy generally, undergo long-term trends which the actuary should keep his eye on and allow for but market yields also fluctuate quite substantially in the short term. Mr Greenwood gave us some examples of the rate of change of various market figures. Those kind of changes can happen without the actuary finding any substantial difference in his long-term outlook. So an office could be in the black one year and in the red the following year simply because of a fluctuation in the investment markets which was not of real significance to that office. This gave rise to the resilience test.

It was unfortunate that we attached the name 'mismatching' to it, because it is not, in fact, a mismatching test. It is a test of whether the valuation basis can be maintained in the face of short-term investment fluctuations, and it is not intended to pre-empt a proper mismatching reserve, which is normally done on a gross premium basis. Such a test ought not to be too strong, because there are other margins. It should not exhaust the possible scenarios that the actuary ought to consider. It ought to be simple; it can be rough and ready. I learnt from this paper that those objectives have been met. But there have been a number of comments on the test itself.

Sections 2 and 3 of the paper will be very helpful to the actuary, and I suspect they will also be helpful to GAD.

It has been suggested that the relationship with other margins should be looked at again, and that it is not particularly reasonable that there should be a resilience requirement on a distant with-profits liability where the fluctuation risks are amply covered by other margins. The interesting point was made that an office cannot plan because it does not know exactly what GAD will do if extreme circumstances occur. This is quite an intractable problem. It is very difficult for GAD to state in any authoritative way what it would actually do in hypothetical circumstances. The question has to be asked, and it is difficult to answer. The relationship to investment policy was also mentioned. The test, having originated as I described, was not conceived of as having any relationship to investment policy. However, it has been pointed out that resilience reserves may be required even if business is perfectly matched, and that its requirements pull against the needs of cash flow mismatching. These points also need to be considered.

The paper has an interesting suggestion as to how the requirements should taper off as the rate of interest changes, and the need for some revision in this was generally agreed. Mr Newton, apparently, was willing to go rather further. Mr Scurfield said that he was considering setting up a Working Party to make a fundamental review of the matter.

The opener referred to the rather mysterious reserves called V_2 and W_3, and others. I am not sure that these are covered adequately in the literature. Some of them were brought up by the Wales Working Party (*J.I.A.* **102,** 61), in 1975. Perhaps it is time to look again at these methods and see whether we should be sticking to the net premium method.

There is a great deal in the discussion, as well as in the paper, which needs to be read by Appointed Actuaries and valuation actuaries. We are agreed on the main points.

If we are going to have a resilience test it cannot go much beyond the sort of test that we have now. The crucial question is how the limits should vary as circumstances vary. Paragraph 2.6 seems to me to be sensible. But in the last analysis the profession has to rely on GAD to alter those limits as and when it is sensible to do so. I see no other way of doing it. That leads me to two conclusions. One is that the test itself should not be incorporated in the Regulations. It should remain an informal working rule. The other is to underline the importance of the Joint Working Party with GAD and the profession where questions such as these limits can be aired from time to time against a changing context.

Much of our thinking in GAD was groping towards some form of testing scenarios, and a good deal of what has been said about cash flow mismatching here is also moving in that direction. The trail blazer in this is the State of New York, which offers its companies the option of using eight pre-determined—not stochastic--scenarios, and testing their reserves against those. The reason I say 'offer' is that, regulation being what it is in New York, this produces lower reserves than the companies would otherwise have to hold. Having seen something of what they are doing I was struck by the enormous complexity of the scenarios. It is no simple exercise. The resilience test probably goes about as far as it can in the direction of scenario testing while the Regulations are based on net premium reserves.

What, therefore, will be the next step for the profession? We need to study the coherence of the mismatching reserves. We also need to develop gross premium reserving along with scenario testing and integrate that with actuarial planning and investment strategy. The Appointed Actuary can make an input in all these fields.

The President (Mr R. D. Corley): The ten members of the Working Party have now tackled two substantial tasks and produced two valuable papers for the profession. However, as they point out in their concluding paragraphs, they have not yet reached a stopping place and there are some fairly obvious developments of their work which must now be undertaken. A substantial number of other and different areas for investigation have been suggested during the discussion and it is clear that the subject is still evolving rapidly.

It would be tempting to build on the success to date by suggesting that this group, who have demonstrated how well they can work together, should be asked to reconvene to progress their own line of work further. However, I think it better to resist this temptation and, as you have heard, the Chairman of the Life Assurance Joint Committee in conjunction with the JAWP, when appropriate, will be setting up new Working Parties for the next stages. This action allows others to contribute to the work and spreads the burden. It also, importantly, reassures potential volunteers that members of Working Parties can expect to be released when the specific objectives have been achieved! Of course, I would not wish to dissuade any of the authors of this paper from volunteering again for another round with one of the new teams, and some continuity is highly desirable.

However, for the present, having seen the group work so well together and so productively for a period of three years under the capable chairmanship of Mr Purchase, it is with considerable pleasure that I thank them all for their efforts.

Mr D. E. Purchase (replying): I agree with the opener in nearly all his remarks—in particular I support his comments on hypothecation of assets and the reasonableness or otherwise of the way in which this should be carried out, and also his views on the treatment of property and other assets. One or two speakers had a go at the Wilkie model. The Working Party members were in a quandary when they came to this part of the paper because we had been told that the Wilkie model was no good, and that one of our tasks should be to start again from scratch with a few eminent economists and come up with a model that the profession could use with confidence. However, we were not the right Working Party to do this, and if a paper on resilience testing was required we either used the Wilkie model, warts and all, or we left out Section 5. The results in that section may be of interest to some; they may be of a little value. I certainly agree that it would have been helpful to run similar investigations using different starting parameters, but there was not sufficient time.

There were a number of comments on the speed at which economic changes took place, and some speakers suggested that in most situations there is time for action by the management of a life office. While I do not disagree with that view, I nevertheless think—and the Working Party's discussions lead me to believe they would agree with me—that it is right in principle that there is a test in the big bang situation. In other words, if something happens too quickly for any action to be taken, then what is the consequential effect?

The Working Party was set up three years ago shortly after the working rule 'escaped', to use Mr Hazell's word, from the GAD, where it was supposed to be kept in close confinement, and was promulgated to the world. I have no doubt that if a new Working Party, working in the same field, were set up now the questions would be entirely different. We did feel that for the purposes of our investigations some things had to be taken for granted. For instance, the use of the net premium valuation for regulatory purposes. We were reminded this evening that, with 1992 only three years away, it is improbable that a major change to that underlying concept will take place.