A MODEL OFFICE INVESTIGATION
OF THE POTENTIAL IMPACT OF AIDS
ON NON-LINKED LIFE ASSURANCE BUSINESS

By Faculty of Actuaries Mortality Research Group
M. Ljeskovac, B.Sc., Ph.D., F.F.A.; D. C. M. Dickson, B.Sc., Ph.D., F.F.A.; S. Kilpatrick, B.Sc., F.F.A.; A. S. Macdonald, B.Sc., F.F.A.; K. A. Miller, B.Sc., F.F.A.; and I. M. Paterson, B.Sc., F.F.A.

1. INTRODUCTION

1.1 The Aim of the Paper

The aim of this paper is to use a model office to examine the potential impact of AIDS on non-linked life assurance business in the UK.

1.2 The IAWP AIDS Bulletins

The subject of AIDS continues to stimulate a large amount of research. The UK actuarial profession has been kept informed by the regular Bulletins [1-5] from the Institute of Actuaries AIDS Working Party (the "IAWP"). Using a model developed by A. D. Wilkie [6], the IAWP examined the possible spread of the infection amongst male homosexuals and produced tables of additional mortality. The most recent Bulletin (No.4), published in March 1989, updated these projections in the light of new data, and we have based our investigations principally upon these more recent projections.

The IAWP did not explore the effect of AIDS on any particular office. However, towards the end of 1987, the Government Actuary advised Appointed Actuaries to investigate the potential effect of AIDS on their offices' portfolios and to set up additional reserves if necessary. Following further guidance from the Government Actuary's Department, in November 1988, additional reserves set up in the 1988 valuations were to be at least as strong as was consistent with Basis F (one of the earlier projections) of the IAWP, although existing mortality margins could be taken into account. In December 1989, these guidelines were revised and ought now to be as strong as is consistent with Basis R, extended by assuming that the additional mortality at each age due to AIDS does not decline from its peak.

1.3 Actions Taken by Offices

For business already in force before the effects of AIDS were realized, life offices

have been unable to take action retrospectively to recoup the likely additional costs, except that with-profit business may ultimately be able to meet the cost out of bonuses. In general, action has been restricted to setting up additional valuation reserves out of capital. For new business, offices have attempted to meet the potential extra cost in various ways, principally through underwriting, revising policy designs (particularly with respect to options) and premium rating. These are described briefly in Appendix 3.

On the whole, offices have not changed with-profit premium rates, on the grounds that the extra cost of AIDS mortality can be met out of bonuses and still leave the office with adequate operating margins. One of the aims of this paper is to examine this supposition.

Although these preventive measures have been taken with the aim of protecting the financial position of life offices, most of the results published to date relate to individual generations of business. No investigation of the potential impact of AIDS on an office as a whole has yet been published.

1.4   The Model Office

While each office is different, it is still possible to construct a model which has features in common with many existing life offices. In this paper, we use such a model to show the effect of different assumptions in relation to AIDS.

The model we used is a general purpose PC-based program, originally developed by one of the members of the Group for research and education work, and still in the course of further development. It is being made available at the same time as this paper, since it may be of interest to other actuaries. A description of the model is given in Appendix 4.

1.5   Types of Business Investigated

In considering which types of business to investigate, two types of non-linked contract stand out: term assurances, because of their obvious vulnerability to AIDS, and low-cost endowment assurances, because of the comparatively high element of mortality risk, and because of the large numbers of such contracts which have been written in recent years. We therefore concentrated on these contracts, but we also included ordinary with-profit endowments to show more clearly the effect of the higher sums at risk under low-cost business.

First, we investigated each class of business separately. The results for low-cost and ordinary endowments are given in Section 5, and the results for term assurance are given in Section 6. Then, we constructed a more realistic office writing a combination of each type of contract; the results for this office are given in Section 7.

1.6   The Model Offices

All of the offices were built up by running them forward from 1949 under conditions similar to those which actually prevailed. The assumptions about the future were such that the offices would eventually reach a relatively stable state. These assumptions are described in Section 3.

Premium rates and other policy parameters were hypothetical, and are described in Appendix 2.

1.7   The Methods of Investigation

For with-profit business, our first line of investigation was to assume that premium rates were unchanged and to consider the effect of AIDS mortality on free assets (taken to be the excess of the office's assets over its published liabilities) and on terminal bonus. One can either assume

(a)   that the cost of AIDS death claims is not allowed for in the calculation of asset shares, with the effect that the extra cost of AIDS is met entirely by the free assets, or

(b)   that the cost of AIDS death claims is allowed for in the calculation of asset shares, with the effect of reducing the terminal bonus when a policy becomes a claim. In this case, the extra cost of AIDS for any generation of policies which has not yet reached maturity is absorbed temporarily by the free assets, but is ultimately borne by that generation.

In this paper we will refer to these approaches as "Method 1" and "Method 2" respectively. We do not suggest that either extreme is a realistic course of action, but we found them both to be useful measures.

Secondly, we carried out a series of "sensitivity tests", by varying investment conditions, bonus rates, expense rates, premium rates, and new business expansion rates, in order to compare the effect of these changes with the cost of the AIDS death claims. This gives a useful "feel" for the magnitude of the impact of AIDS.

We could have examined many other interesting aspects of a model office, but time and space constrained the amount which could be included in the paper. We hope that the computer model will be of benefit to those who wish to explore the subject further.

1.8   Contents

The sections of this paper are as follows:

2. CONSIDERATIONS AFFECTING THE CHOICE OF AIDS MORTALITY RATES

2.1   While setting up the model offices for this paper, the Group was in the position of a life office actuary faced with choosing AIDS mortality rates for premium rating and valuation. Our aim from the outset was to explore the implications of the AIDS tables produced by the IAWP, so our choice was limited, but it was still necessary to examine their suitability for the task, both in terms of the features of the IAWP model itself, and the general level of mortality predicted by the model. This section is a summary of our considerations.

2.2   The IAWP model, like many others, is of homosexual spread only. Given the then available data, no other assumption could have been made. However, the model is calibrated to reproduce total deaths from AIDS in the UK. The following table shows, of the cumulative totals of persons HIV-positive and persons with AIDS in the UK to the end of September 1989, the proportions in the major risk groups [7].

| | Proportion of Total | |
Risk Group	HIV-positive	With AIDS
Homosexual/bisexual	48.0%	79.8%
Intravenous drug abuser	15.0%	2.3%
Haemophiliac	9.8%	7.3%
Other undetermined	17.8%	1.8%
Other risk groups	9.4%	8.8%

Even assuming that most "other undetermined" are homosexual or bisexual, the patterns of HIV infection and AIDS cases are different. The figures for HIV infection suggest that homosexual spread is no longer so predominant as to justify calibrating the model with the UK totals. Nor is it really correct that this makes an implicit allowance for deaths in other risk groups, unless AIDS spreads in a similar way in all risk groups. We may be approaching the stage at which future projections from this model should be calibrated against the homosexual/bisexual group alone.

2.3   Where we have used the IAWP tables F and R as they stand, it should be clear that the results apply only to the effects of homosexual spread. However, for term

assurance business there is little point in accepting such a restriction beyond the very short term, since any further spread of AIDS will affect premium rates, and it is not satisfactory to assume that the mortality experienced by assured lives will fall just because this may be the case for homosexual males. We have therefore used the "Extended R" table described in 2.9 in an attempt to make some allowance for future spread.

2.4   Another troublesome point was the heterogeneity of the at-risk population. The IAWP model assumes that the at-risk population is subdivided only by age, and each age group forms a closed risk group. Partly, the reason was the desire for age-related rates for actuarial use. Given a choice, any actuary might be expected to favour age-related rates over aggregated rates. However, a glance at case statistics shows that, although AIDS mortality does appear to be age-related, the data supports other subdivisions, behavioural and geographical. Subdivision by age, therefore, is unlikely to give homogeneous risk groups.

If the risk groups in use are not homogeneous, one must ask how AIDS might spread beyond those groups already affected. On epidemiological grounds [8] it may be expected that the spread will slow down as the groups with highest risk become saturated, and the spread takes place in groups with lower risk. The existing data will not allow such heterogeneity to be modelled with any accuracy; before that can be done there is a need for a convincing survey of sexual behaviour. However, there is evidence of changing sexual behaviour among homosexuals [4], and the more recent IAWP tables have, by adjustments to the rate of infectivity, allowed for some degree of heterogeneity and/or changed behaviour among homosexuals. The problem of geographical differences remains.

AIDS has spread most rapidly among homosexuals and bisexuals in London, intravenous drug abusers in Edinburgh, and recipients of blood products. Restricting attention to homosexuals, the predominance of London in the case counts raises doubts about whether homosexuals at risk in the U.K. form a geographically homogeneous group, or whether they comprise significantly different risk groups in different parts of the U.K. If the latter, it is possible that the U.K. total of AIDS cases represents a high rate of infection in just part of the total at-risk population (namely homosexuals in London), and a low rate of infection so far in the remainder.

The following table shows the regional imbalance in the cumulative total of reported AIDS cases and HIV-positive reports, in the male homosexual/ bisexual risk group, notified to the Public Health Laboratory Service (PHLS) up to the end of June 1989. The numbers of reports in each Health Region in England [9] are divided by the mid-1987 male population between ages 15-59 [10] and the resulting proportions are expressed as a percentage of the corresponding proportion for the four Thames Health Authorities combined. This baseline was chosen to reduce the dominance of the North-West Thames Health Authority.

Cumulative AIDS cases and HIV positive reports per 1000 male population aged 15-59, expressed as a percentage of similar figures for combined Thames Health Regions.

Health Region	AIDS Cases	HIV +ve Reports
Northern	7.4%	15.7%
Yorkshire	9.3%	15.9%
Trent	7.1%	11.4%
East Anglian	8.6%	14.9%
NW Thames	221.3%	240.3%
NE Thames	91.8%	66.2%
SE Thames	52.8%	61.2%
SW Thames	19.9%	19.5%
(Thames combined	100.0%	100.0%)
Wessex	10.9%	16.7%
Oxford	10.1%	18.6%
South Western	10.7%	16.3%
West Midlands	7.0%	9.7%
Mersey	8.3%	10.5%
North Western	16.7%	22.5%

It is interesting that the figures for HIV positive reports are higher than the figures for AIDS cases in every area outside Thames. One possible explanation is that AIDS victims may tend to seek treatment in London after diagnosis.

If there is any significance in the London weighting, we would draw two tentative conclusions. First, apart from scale, the IAWP model may be more suitable as a regional model than as a national model. Again, the fact that the IAWP model is calibrated using U.K. totals is significant. Much depends on the proportions of homosexuals in different parts of the U.K., on which we have no data. Second, the most recent trends in the data imply that the IAWP projections are over-estimates, but if AIDS has yet to spread out from its earlier centres then it may be a case of "too soon" rather than "too high".

In practical terms, we felt that the lower numbers of reported cases did not yet justify the use of the more optimistic IAWP tables (ie lighter than basis R), even before considering the additional problems of under-reporting and heterosexual spread.

2.5   In a similar vein, we were interested to note that the Canadian Institute of Actuaries has suggested AIDS reserves which take account of the amount of business which an office has written in the major cities, and the relative incidence of AIDS in those cities [13].

2.6   There is evidence that not all AIDS cases are reported. In particular:—

(a)   It has been shown by McCormick [11] that mortality among single men aged 25-44 increased between 1985 and 1986, and that the increase was more than double that which could be accounted for by reported AIDS deaths. When causes of death were examined, it was clear that most of the increase was due to causes associated with AIDS.

(b)   The United States General Accounting Office [12] investigated the data available to AIDS researchers in the U.S.A., and estimated that between 35% and 41% of AIDS cases (as distinct from AIDS deaths) had not been counted.

This must throw some doubt on the effectiveness of AIDS exclusion clauses. In practical terms, it seems imprudent to take the reported slowing down of AIDS cases at face value, and it would be unwise to use the more optimistic IAWP tables.

2.7   Given that we had no particular office's portfolio in mind, we saw no grounds for assuming that the population at risk in the in-force business was constituted any differently from the population at risk in the U.K..

2.8   The effects of selection were investigated by the IAWP in AIDS Bulletin No.2 [2], where it was demonstrated that underwriting may not result in experienced AIDS mortality much different from the population AIDS mortality, except in the first few years of assurance, especially if there is any tendency for sums assured to be higher among high risk groups. In the general circumstances which we are considering, these results did not justify any adjustment to the population mortality rates for new business.

We noted that the Canadian Institute of Actuaries [13] has also considered the point. They recommended the use of higher mortality rates for new business (at least 100% of population mortality) than for the in-force (60% of population AIDS mortality) on the grounds that, historically, ownership of life insurance was low among the at-risk homosexual population before knowledge of AIDS spread, even although the at-risk lives are now less likely to lapse their policies.

2.9   Somewhat reluctantly, we felt that it was not satisfactory to ignore the possible wider spread of AIDS. As the above remarks make clear, extrapolation of the IAWP tables is a very tenuous procedure indeed. But, putting ourselves once again in the shoes of the life office actuary, doing nothing was not an option.

In Bulletin No.4 [4], the IAWP suggested as a working hypothesis that mortality rates at each age might be assumed to follow basis R up to the year where they peak, but not to decline thereafter. We decided that this was worth exploring; we refer to this hypothesis as the "Extended R" table. It need hardly be emphasised that the results may only be taken to indicate an order of magnitude.

2.10   To represent homosexual spread only, we have used basis R. For more general spread, we have used basis R modified as described above (Extended R) as a baseline. Since the work for this paper was completed, the Government Actuary has issued new guidelines to Appointed Actuaries stating that the mortality table which we have called "Extended R" should replace basis F when considering valuation bases. However, where indicated in the text we have included results under projection F to illustrate the effect of the original guidelines.

3.   THE ASSUMPTIONS USED TO DEVELOP THE MODEL

3.1   The model offices used by the Group were built up assuming financial conditions similar to those prevailing from 1949 until the end of 1988, thereafter moving to stable conditions by the end of 1990. The aim was to create a standard against which to measure the effect of AIDS, and in view of our intention to make the model available to other researchers, we felt that it was unnecessary to take more elaborate steps at this stage. In particular, we felt that it was not appropriate to use a stochastic investment model.

3.2   The investment conditions applying to each calendar year from 1949 to 1987 were derived from the Barclays de Zoete Wedd indices of Retail Prices, Equity Prices, Equity Income Yields and Gilt Yields, and these are shown in Appendix 1. We used the yearly values with no smoothing. The Gilt Yields, although representative of the yields on long term gilts, were applied to dated stocks of all terms, to give a flat yield curve. The coupon on all gilts was assumed to be 9%.

The following values were used for 1988, 1989 and 1990 and later.

	1988	1989	1990 and later
Rate of Retail Price Inflation	6.8%	8.0%	6.0%
Gross Dividend Yield	4.8%	4.8%	4.5%
Rate of increase in Equity prices	7.6%	20.0%	6.0%
Gross redemption yield on gilts	9.3%	9.2%	9.0%

The model assumes that all cashflows, including income from assets, take place at the end of the year. The dividend yield therefore represents the dividend paid at the end of the year divided by the share price at the start of the year; the rate of increase in equity prices is based on the share price at the end of the year divided by the share price at the start of the year, and the gilt yield is calculated assuming the coupon to be payable at the end of the year.

3.3   The investment strategy adopted by the office was a simple one. It was assumed that the with-profit fund was invested 50% in gilts and 50% in equities at the

outset in 1949. The proportion invested in equities was then increased in steps of 10% every 10 years, finally reaching 80% in 1979. The non-profit fund was invested wholly in gilts. The asset backing of the individual policies, or in other words, the investments backing the asset shares, were assumed to follow the same strategy. The gilt component of the asset share of each policy was invested in gilts of the same outstanding term as that policy.

3.4   Rates of tax and tax relief were as follows:

Period	Corporation Tax	Income Tax	Tax Relief
1949-72	37.5%	37.5%	37.5%
1973	37.5%	30.0%	37.5%
1974	37.5%	33.0%	37.5%
1975-76	37.5%	35.0%	37.5%
1977	37.5%	34.0%	37.5%
1978	37.5%	33.0%	37.5%
1979-85	37.5%	30.0%	37.5%
1986	35.0%	29.0%	35.0%
1987	35.0%	27.0%	35.0%
1988	35.0%	25.0%	35.0%
1989-	25.0%	25.0%	25.0%

3.5   The compound reversionary bonus rates in respect of premiums paid during each year were as follows:

| Years | Rate of Reversionary Bonus | |
	on Sum Assured	on Bonus
1949-58	2.5%	2.5%
1959-68	3.5%	3.5%
1969-78	4.5%	4.5%
1979-83	4.0%	5.0%
1984-	3.0%	6.0%

Terminal bonuses were paid throughout the period, based on 90% of the asset shares for deaths and maturities before 1984, and 100% of the asset shares for deaths and maturities after 1983, if these amounts exceeded the guaranteed benefits. Although, in the earlier years, this is slightly anachronistic, the effect is small because few maturities occur before 1970.

3.6   The valuation basis was an unzillmerised net premium basis, using A1967-70 ultimate mortality and a rate of interest of 3% for with-profit business and 5% for non-profit business. The term assurance portions of low-cost endowments were valued by

calculating the future sums at risk assuming a bonus rate of 2.5%, and valuing these at 5%. Net premiums were limited to 90% of office premiums, and negative values were excluded. A solvency margin of 4% of the reserve and 0.3% of the sums at risk was included. Again, the slight anachronisms in this basis were ignored.

3.7   Commission was based on LOA (non-indemnity) scales during 1949-88, and LAUTRO (non-indemnity) scales from 1989 onwards. Other initial expenses were 50% of the initial commission, and a per-policy expense, linked to inflation, calculated so as to be equal to £40 in 1984. The other renewal expense was a per-policy expense, also linked to inflation and calculated so as to be equal to £10 in 1984. These gross expenses were netted at the rates given in 2.4 above.

3.8   All classes of policy carried an annual policy charge, linked to inflation for new business (but fixed for in-force business) and calculated so as to be equal to £10 in 1984.

3.9   In general, a rate of new business expansion of 8% per year was consistent with some real growth of the office, both in the past and in the future. However, the actual rates of new business expansion depended on the class of contract. Ordinary 10 year ordinary endowment business was assumed to represent a market for savings not related to mortgages. Therefore it was unaffected by the introduction of low-cost endowment business in 1969, and so was assumed to grow at 8% per year throughout. Similarly, term assurance business was supposed to represent an isolated market, and was also assumed to grow at 8% per year. 25 year ordinary endowment business was assumed to grow at 8% per year until low-cost endowments were introduced in 1969, and at 0% per year thereafter. The inflation of the 1970s then reduced this part of the business to a realistically low level. Low-cost endowment business was assumed to grow as follows:

Period	Rate of New Business Growth
1969—1978	10% per year
1979—1983	50% per year
1984—1988	25% per year
1989 -	8% per year

In all cases the average premium per policy was assumed to increase in line with the RPI; the excess of the rates of new business expansion given above over the rate of increase of the RPI therefore represents the real growth in the office's business.

3.10   The investigation only covers male lives. The IAWP tables apply only to male homosexuals, and there are not yet sufficient data to support projections of female AIDS mortality.

3.11 We assumed that there were no lapses. Although it would be interesting to investigate the effect of selective lapsing this fell outside the scope of our investigation.

4. ASSESSING THE IMPACT OF AIDS

4.1 Our "knowledge" of the effect of AIDS over the long time periods in which actuaries are interested is, as yet, very speculative, and projections contain a particularly high element of uncertainty. Even so, they can be made to serve a useful purpose. This paper concentrates on two approaches.

(a) Accepting that the course of the epidemic could lie anywhere between unknown extremes, we can ask "what if?" questions about different outcomes. We shall avoid saying that an outcome is "mild" or "severe"; at this stage such statements are too subjective.

(b) A most useful approach is to try to put the possible effect of AIDS into perspective. We are quite used to volatility in other factors, such as investment returns, and it might be revealing to compare the effect of AIDS with small changes in these other factors.

4.2 We examined three types of policy, namely

(a) with-profit ordinary endowments,

(b) low-cost endowments, and

(c) term assurances.

Low-cost endowments were felt to be particularly interesting, because the expansion of this class of business in recent years has greatly increased sums at risk in many offices.

4.3 As a measure of the financial condition of a whole office we chose the ratio of the office's assets to its published liabilities. "Assets" includes any free estate left behind by previous generations of policyholders, although in the subsequent projections this element does not play a significant part. "Liabilities" means the liabilities on the basis chosen by the actuary for publication in Form 55 of the DTI Returns, plus the statutory solvency margin based on these reserves. We refer to this ratio as the "A/L ratio".

4.4 Assuming that there is no change in with-profit premium rates, the effect of AIDS on with-profit business depends on how death claims are accounted for when calculating the assetshares.

Our assumption for non-AIDS death claims is that the claim amounts in respect of policies which entered in any one year are deducted from the assetshares of those policies. Since the model assumes that terminal bonus is derived from the assetshares at maturity, each generation of business ultimately supports its own mortality experience, and the effect on the office as a whole is neutral.

We considered two approaches to the calculation of asset shares in the presence of AIDS mortality.

(a)   "Method 1"

    We assumed that AIDS death claims were ignored in the calculation of asset shares. Maturing policies therefore receive the same benefits as if there were no AIDS mortality; the cost is not passed on through the bonuses. The extra cost of AIDS mortality is met entirely from the office's free assets. We do not suggest that this is a course of action to be recommended, we simply found it useful because it revealed the cost of AIDS as a charge on the office's free assets. The measure of this effect was taken to be the change in the A/L ratio.

(b)   "Method 2"

    We investigated a second possibility, namely that AIDS death claims were allowed for in the calculation of assetshares in the same way as non-AIDS death claims. This gives another measure of the cost of AIDS, namely the reduction in emerging terminal bonus rates on maturing policies. Note, however, that AIDS death claims reduce free assets even if their cost is eventually passed on to policyholders *via* terminal bonus, because death claims made before a policy reaches maturity must be met out of the office's assets but the reduction in the office's liability due to the exit is normally less than the amount of the claim; in other words there is usually a positive death strain at risk. Therefore we do not look at the effect on terminal bonus in isolation, but in conjunction with the (moderated) reduction in the A/L ratio.

4.5   We examined two modifications to the net premium valuation basis used in the model, measuring their effect on the A/L ratio. They were :-

(a)   allowing for AIDS in the valuation factors but not in the calculation of the net premium, and

(b)   allowing for AIDS in both the valuation factors and in the calculation of the net premium.

The effect of (a) is always to increase reserves, but (b) may represent either a stronger or weaker basis than that with no AIDS mortality at all. We included (b) because it was explicitly permitted in the Government Actuary's guidelines to Appointed Actuaries of November 1988.

4.6   It is useful to compare the effect of AIDS with the effect of other, more familiar factors. A life office is subject to many influences, some of which may be more significant than AIDS, and it is important to consider this wider context. We therefore selected several factors and attempted to measure the change which would be required in each of these factors to compensate roughly for the cost of AIDS. Our measure for these "sensitivity tests" was the A/L ratio.

For these projections, we assumed that AIDS mortality followed the Extended R table, and that the same additional mortality was allowed for in the valuation factors but not in the calculation of the valuation net premiums.

The factors which we considered fell into four groups. Some were not appropriate for all classes of business; details of the tests actually carried out are in Sections 5 and 6.

(a)   Changes in conditions which immediately increase the cash inflow (or decrease the cash outflow). These were:—

   (i)   An increase in the ultimate gross rate of return earned on all assets.

   (ii)   A reduction in per-policy expenses, representing increased expense efficiency.

(b)   Levies on maturities, or on new business, which will ultimately result in a more favourable cashflow but whose action is deferred or gradual. These were:—

   (iii)   A charge levied on maturing policies, expressed either

      (a)   as a percentage of the assetshare at maturity, or

      (b)   as a deduction from the net rate of return credited to accumulating assetshares.

   (iv)   Increases in premium rates.

(c)   Changes which act immediately by reducing reserves. These were:—

   (v)   An increase in the valuation rate of interest.

   (vi)   Changing the valuation mortality table from A1967-70 ultimate to the CMI 1979-82 graduated experience (ultimate).

(d)   Actions which increase the A/L ratio over a period of time. These were:—

   (vii)   A cut in the rate of bonus on sum assured.

   (viii)   A cut in the rate of bonus on bonus.

   (ix)   A reduction in the rate of expansion of new business.

4.7   The model was run forward in four year periods from its supposed inception in 1949. Thus the results and the graphs are based on the A/L ratios in the years 1985, 1989, 1993, 1997, 2001, 2005, 2009, 2013, 2017 and 2021.

5.   WITH-PROFIT POLICIES

5.1   Introduction

"With-profit policies" covers low-cost and ordinary endowments. The premium bases and rates used are given in Appendix 2. The ordinary endowment policies were assumed to start in 1949; the low-cost endowment business started in 1969.

We projected business for lives aged 30, 40 and 50 at entry, but the results given below refer to a combination of equal amounts of new business premium at each of these ages.

For ordinary endowment business, new business premium income was assumed to be evenly split between 10 year and 25 year policies until 1969, after which the level of new business at term 25 years was assumed to remain constant following the introduction of low-cost business. For low-cost endowments, only 25 year policies were considered. We felt that this was reasonable in view of the predominance of low-cost endowments at the 25 year term in recent years.

5.2   Asset/Liability Ratios and Terminal Bonus

5.2.1 The Baseline Projection

The "baseline" projection referred to throughout this section is a projection with no AIDS mortality. The A/L ratios of this projection may be regarded as the "norm", and the effect of AIDS can be measured by the departures from this baseline.

In later sections, A/L ratios are expressed as percentages of the baseline A/L ratio. For example, if the baseline A/L ratio were 1.20, and the A/L ratio on some other projection allowing for AIDS had fallen to 1.08, this would be expressed as "90% of the baseline". We preferred this relative measure to the use of the absolute A/L ratios because these are not constant over the time period considered, and the reader would have had to consult the baseline projections repeatedly to make sense of them. Bearing in mind that the "A" of the A/L ratios represents only the assets generated by the contracts under consideration, the absolute level is not so important; in particular it does not matter if A/L is less than 1.

Graphs 501 and 502 show the A/L ratios of the baseline projections for low-cost endowments and ordinary with-profit endowments respectively. These change over time as the office gradually stabilizes under the conditions assumed to apply after 1989.

For low-cost endowments (Graph 501) the overall ratio rose to 1.29 in 1985 before falling to around 1 from 1997 onwards. (The overall ratios are not graphed as they are almost identical with those for lives aged 40.)

For ordinary endowments (Graph 502) the pattern was similar. The overall ratio rose to 1.69 in 1989, then fell to 1.13 in 2009 before rising slightly again. The individual

A/L ratios for both 10 and 25 year policies separately followed this pattern, but at different levels.

Emerging terminal bonus rates for low-cost endowments, expressed as a percentage of the sum assured plus attaching reversionary bonus, are shown in Graph 503. They fell from a level of between 150% and 220% and stabilised after 2017 at levels between 23% and 44%, depending on age. Note that the first maturities occured in 1994.

Emerging terminal bonus rates for ordinary endowments, expressed as a percentage of the sum assured plus attaching reversionary bonus, are shown in graph 504. For 10 year policies these stabilised around 11% after 2001 having reached a peak close to 100% in 1985. For 25 year policies the rates peaked later and at much higher levels before reducing and stabilising at levels between 20% and 26% from 2017.

5.2.2 Effect of AIDS mortality on Asset/Liability Ratios

We next introduced AIDS mortality into the experienced mortality but made no other changes to the office. In particular, asset shares were calculated using "Method 1" described in Section 4.4, so that the entire cost of the extra death claims fell on the free assets. Since AIDS death claims were not deducted from asset shares, and terminal bonuses were based on asset shares, terminal bonuses were unaffected by the presence of AIDS mortality. Consequently, the emerging terminal bonus rates were identical to those in the baseline.

Graphs 505 and 506 show the effect of AIDS mortality in the experience from 1984. The additional mortality corresponds to IAWP bases F, R and Extended R. The A/L ratios on each mortality basis were virtually the same as the baseline until 1993 for low-cost endowments and until 2001 for ordinary endowments. (Note that the graphs only display the A/L ratios from 1989 and 1997 respectively.)

For low-cost endowments (Graph 505) the A/L ratios remained around 97% of the baseline on bases F and R from 2001 onwards. On Extended R, the A/L ratios dropped steadily after 2001 to around 93.5% of the baseline ratio in 2021.

For ordinary endowments (Graph 506) the pattern was similar, but less pronounced. The A/L ratios were virtually identical to the baseline ratios up to 2001. The ratios then fell, and on bases F and R, they stabilized at about 98.5% of the baseline in 2009, while on Extended R they gradually fell to 97.5% of the baseline by 2021.

The reduction in the A/L ratio is the result of the interaction of a reduction in both the assets and the liabilities. The reduction in the assets is therefore slightly greater than the reduction in the A/L ratio would suggest. To show the relative magnitude of these two changes, Graphs 505a and 506a show, for low-cost endowments and ordinary with-profit endowments respectively,

(a)   the assets allowing for AIDS mortality on the Extended R basis as a proportion of the assets with no AIDS mortality, and

(b)   the liabilities allowing for AIDS mortality on the Extended R basis as a proportion of the liabilities with no AIDS mortality.

5.2.3 Allowance for AIDS Claims in Asset Share calculations

We next assumed that claims arising as a result of AIDS mortality were deducted from the asset shares, in line with the treatment of other death claims (called "Method 2" in Section 4.4). Consequently, such claims are met temporarily out of free assets but eventually charged against terminal bonus.

For low-cost endowments (Graph 507) the A/L ratios exceeded those in 5.2.2 at all durations, more so in later years. On bases F and R, the A/L ratios were 99% of the baseline by 2021, and on Extended R, 95.5% of the baseline ratio.

For ordinary endowments (Graph 508) the same pattern emerged, but by 2021 the A/L ratios on bases F and R had recovered and were effectively equal to the baseline ratio; while on Extended R, the ratio was 99.5% of the baseline.

The table below compares the A/L ratios for low-cost endowments under "Method 1" (AIDS death claims not deducted from asset shares) and "Method 2" (AIDS death claims deducted from asset shares). For clarity, only the Extended R basis is shown. This demonstrates clearly that, although the cost of AIDS may ultimately be borne by the appropriate generations of policyholders, the need for the estate to provide temporary support for the AIDS mortality experienced by the in-force business still makes a significant demand on the office's capital.

A/L Ratios based on Extended R table

Year	"Method 1"	"Method 2"
1989	1.2132	1.2132
1993	1.1341	1.1341
1997	1.0096	1.0096
2001	0.9598	0.9598
2005	0.9602	0.9602
2009	0.9649	0.9654
2013	0.9587	0.9614
2017	0.9471	0.9571

Graphs 509, 510 and 511 show the patterns of emerging terminal bonus rates for low-cost, 25-year ordinary and 10-year ordinary endowments respectively, expressed as a percentage of the terminal bonus rates on the baseline projection. These graphs are based on policies issued to lives aged 40.

By 2021 the emerging terminal bonus rates for low-cost endowments (Graph 509) had fallen to about 80% of the baseline level on bases F and R, and to 75% on Extended R.

For 25-year ordinary endowments (Graph 510) terminal bonus rates had fallen by 2021 to about 88% of the baseline on bases F and R, and to about 85% of the baseline on Extended R. 10 year policies (Graph 511) were different because of their shorter duration. Terminal bonus rates did not fall below about 93% of the baseline; on bases F and R the ratios then recovered from this level, while on Extended R they remained low.

5.3 Allowance for AIDS Mortality in Valuations

We introduced AIDS mortality into both the experience (from 1984) and the valuation bases (from 1989). In 5.3.1 we allow for AIDS mortality in the valuation factors but not in the net premiums, and in 5.3.2 we allow for AIDS mortality in both the valuation factors and the net premiums. We also assumed that the same AIDS mortality rates apply to the experience as are used in the valuation, and that "Method 2" of calculating asset shares was used; that is, AIDS death claims were deducted from the asset shares.

We assumed that asset share calculations are unaffected by the choice of valuation basis, so emerging terminal bonus rates in these projections were the same as those in 5.2.3.

5.3.1 AIDS in valuation factors only

For low-cost endowments (Graph 512) the ultimate level of the A/L ratio was similar to that in 5.2.3 (Graph 507) on bases F and R, while on Extended R it was some 2% lower (relative to the baseline). In all cases, as would be expected, the decrease in the A/L ratios was immediate rather than deferred. The immediate reductions were around 5%, 4% and 4.5% from the ratios in 5.2.3 on bases F, R and Extended R respectively.

The A/L ratios for ordinary endowments are not graphed as they were all within 1% (relative to the baseline) of those in 5.2.3 (Graph 508).

5.3.2 AIDS in valuation factors and net premiums

In these projections, the assumptions were the same as in 5.3.1, except that the net premiums were recalculated to include AIDS mortality.

For low-cost endowments, on all of the AIDS mortality bases, the A/L ratios fell to about 99% of their previous level immediately after the introduction of AIDS mortality into the valuation basis. They then rose slowly and actually stabilized just above the A/L ratios assuming *no* AIDS in the valuation basis.

For ordinary endowments, on all of the AIDS mortality bases, there was almost no

change in the A/L ratios upon changing the valuation basis, and again they stabilized very slightly above those assuming no AIDS in the valuation basis (Graph 508).

Therefore, the inclusion of AIDS mortality in the net premium ultimately represents a weakening of the basis.

5.3.3 The following table shows the percentage changes in the reserves for low-cost endowments immediately following the changes to the valuation basis in 1989.

Percentage Change in Reserves on changing valuation basis in 1989

AIDS Mortality Table	AIDS in Valuation Factors only	AIDS in Valuation Factors and Net premiums
F	+5.2%	+1.0%
R	+4.1%	+0.7%
Extended R	+4.6%	+0.8%

5.3.4 The following table shows the percentage changes in the reserves for ordinary with-profits endowments immediately following the changes to the valuation basis in 1989.

Percentage Change in Reserves on changing valuation basis in 1989

AIDS Mortality Table	AIDS in Valuation Factors only	AIDS in Valuation Factors and Net premiums
F	+0.24%	+0.09%
R	+0.17%	+0.06%
Extended R	+0.18%	+0.06%

5.4   Sensitivity Tests

As described in Section 4 we considered factors which, taken one at a time, improved the fund's financial position and reduced, in varying degrees, the adverse effect of AIDS mortality on the office's free assets. Two points concerning this procedure should be noted:

(a)   We are measuring the effect of the factors on the financial position of a whole office, not that of a single policy or generation of policies. Therefore the size of the change required in any factor to show rough equivalence to the effect of AIDS mortality should not be judged by reference to any calculations made for a single policy.

(b) The changes made in the sensitivity tests are not being put forward as suggested courses of action, even in those cases where that may be feasible. They are put forward only as yardsticks against which to measure the magnitude of the effect of AIDS.

Throughout this section, the following assumptions were made corresponding to those used in the projections on the Extended R basis in 5.3.1 (Graph 512).

(a) AIDS mortality on the Extended R basis was introduced into the experience in 1984, and into the valuation basis in 1989.

(b) AIDS mortality was ignored in the calculation of net premiums.

(c) AIDS death claims were deducted from asset shares in line with the treatment of other death claims ("Method 2" of Section 4.4).

Where results are quoted explicitly they are expressed as percentages of the baseline A/L ratios. To show the extent to which the change being tested is comparable with the effect of AIDS. the following table shows the A/L ratio on the projections using the Extended R basis in Section 5.3.1, expressed as a percentage of the same baseline.

A/L Ratios from Section 5.3.1 as percentages of Baseline

Year	Low-Cost Endowments	Ordinary Endowments
1989	100%	100%
1993	94.9%	99.7%
1997	94.4%	99.5%
2001	94.2%	99.3%
2005	94.2%	99.1%
2009	94.1%	98.9%
2013	93.7%	98.9%
2017	93.4%	98.9%

5.4.1 Increase in Rates of Return

First, we considered additions, from 1989, both to the gross redemption yields on gilts and to gross equity dividend yields. These additions increased the office's assets while the liabilities were unaffected, so the A/L ratio was increased. The extra assets were only held in the fund temporarily, however, since they represented accruing terminal bonuses and were returned to policyholders on death or maturity.

For low-cost endowments Graph 513 shows that a 0.5% gross increase was not sufficient and a 1.0% gross increase was needed to restore the overall A/L ratio to the baseline level, though this was not attained until 2009. The pattern was similar for the

individual policies.

By contrast, Graph 514 shows that for ordinary endowments an increase of 0.5% was more than sufficient; the overall A/L ratio in 1993 was 100.2% of the baseline and by 2021, almost 103%. The pattern was similar for individual policies.

5.4.2 Decrease in per-policy expenses

Next, we considered a 10% reduction in per policy expenses from 1989. Again the effect was to increase the assets, and hence the A/L ratio, but the improvement was temporary since the asset shares and consequently the terminal bonuses were based on these experienced expenses.

For low cost endowments the effect was minimal. The overall A/L ratios were only slightly increased from those in Section 5.3.1 (by 0.1% in 1993 and 0.4% in 2021) and did not come close to the baseline. There was equally little effect on ordinary endowments. The A/L ratios were very close to those in 5.3.1 and were still below the baseline by 2021.

5.4.3 Levy on Claims

We considered the possibility that an office could levy a charge on the asset share of a policy becoming a claim, by reducing the terminal bonus. The levy would clearly not be returned to the policyholder, and would be a permanent addition to the office's free assets. The liabilities would not be affected, so the A/L ratio would be increased, but note that unlike the two factors considered above the increase in the assets only arises through policies becoming claims; no in-force policy enjoys the benefit of the contribution which it will itself make to the strength of the office. We considered two methods of calculating such a levy.

(a)   Reduced Proportion of Assetshare

For low-cost endowments (Graph 515) a reduction of maturity values to 95% of asset shares from 1989 would not negate the effect of AIDS. Under this assumption the overall A/L ratios would only have attained about 97.3% of the baseline by 2021. If only 90% of asset shares were paid out, however, the A/L ratios would be 101.2% of the baseline by 2021. In both cases it can be seen from the graph that the effect was very slow to filter through to the A/L ratios.

For ordinary endowments (Graph 516) paying out only 95% of asset shares greatly overcompensated for the AIDS mortality. The A/L ratios rose steadily to about 147% of the baseline by 2021. Even if only 99% of the asset shares were paid out, the change would overcompensate from 1989 onwards, with the A/L ratio in 2021 being 108.5% of the baseline.

(b)   Reduced rate of return on Assetshares

Next, we assumed that maturities were based on 100% of an asset share which had been adjusted by reducing by 0.5% the net rate of return used in the accumulation of the asset share from 1989 onwards.

For low-cost endowments (Graph 517) this change almost fully compensated for the effect of AIDS by 2021—the overall A/L ratio then being 99.4% of the baseline. However, the relief was much delayed.

For ordinary endowments (Graph 518) the change overcompensated for AIDS in all future years, with the overall A/L ratio at 2021 being about 130% of the baseline. Reducing the net accumulation rate by only 0.1% still gave a slight overall improvement, with the A/L ratio at 2021 being 105% of the baseline. However, unlike the 0.5% reduction, the effect of the 0.1% reduction was slightly delayed; in 1993, the A/L ratio was still below the baseline.

5.4.4 Increase in Premium Rates

We next examined the effect of a 5% increase in premium rates from 1989. By reducing the sums assured on future new business, this change reduced the valuation liabilities; it also increased the assets slightly because death claims were lower at those durations at which the guaranteed liabilities exceeded the asset shares.

For low cost endowments (Graph 519) comparison of Graphs 519 and 513 shows that the effect on the overall A/L ratios of increasing the premiums by 5% is very similar to that of earning an extra 1% gross yield on the assets, though increasing the premiums was slightly better in the short term and slightly worse in the long term. By 1993 the A/L ratio for the former was about 0.7% higher (relative to the baseline) while at 2021 the ratio for the latter was about 0.7% higher.

For ordinary endowments (Graph 520) the ratios were similar to Graph 514, though the patterns for individual policies were different. For 10 year policies, the ratios were always above the baseline, rising to around 104% of the baseline by 2001 and remaining at this level. For 25 year policies, the change did not fully compensate for AIDS in the first few years after it was introduced, but ratios rose above the baseline by 2005, and gradually rose to around 104% of the baseline by 2021.

5.4.5 Increase in the Valuation Interest Rate

We next increased the valuation interest rate from 1989. This had the effect of immediately reducing the reserves and increasing the A/L ratio.

For low-cost endowments (Graph 521) an increase from 3% to 3.5% produced immediate and very precise relief in the short term (the overall A/L ratio in 1993 was

100% of the baseline). By 2021 the A/L ratio had fallen to 96.8% of the baseline. The pattern was similar for the individual policy classes.

For ordinary endowments (Graph 522) assuming only a 0.25% increase in the valuation rate of interest) the A/L ratio was very close to the baseline at almost all durations. For example it was around 101% of the baseline in 1993, and by 2013 it was marginally below the baseline where it remained thereafter. The pattern was similar for individual policy classes.

5.4.6 Improvement in Valuation Mortality

Next we replaced the A1967-70 table in the valuations from 1989 by the CMI 1979-82 experience, as graduated by A. D. Wilkie for the IAWP [6]. This acts by reducing the valuation reserves. If we assume that the 1979-82 experience will be closer to the non-AIDS mortality which may be experienced by assured lives in future, this gives some idea of the overall effect of the margins available in valuation bases using the A1967-70 tables.

For low-cost endowments (Graph 523) there was only a very slight increase in the A/L ratios, which exceeded those in 5.3.1 but never came close to the baseline. Compared with the ratios in 5.3.1 there was a 1% increase in 1993 but this fell to about 0.4% by 2021. For the individual policy classes, the effect was most marked at older ages; the increases for lives aged 30 and 50 corresponding to those quoted above for lives aged 40 are 0.3% (1993), 0.1% (2021) and 2.5% (1993), 1.0% (2021) respectively.

For ordinary endowments (Graph 524) the change had little effect on the A/L ratios compared with 5.3.1. The overall A/L ratios were slightly greater than those in 5.3.1, but always below the baseline. The slight increases in the overall A/L ratios were entirely due to increases in the A/L ratios for 25 year policies issued at ages 40 and 50.

5.4.7 Reduction of Bonus on Sums Assured

We next considered a reduction from 1989 of 0.25%, then 0.5%, in the reversionary bonus rate on the basic sum assured, without any changes to premium rates. The effect was mainly to reduce the valuation reserves; since death claims at earlier durations were reduced there was also a slight increase in the assets.

For low cost endowments (Graph 525) a reduction of 0.5% in the bonus rate provided the better compensatory effect. The overall A/L ratio gradually improved from about 97.2% of the baseline in 1993 to about 100% of the baseline from 2005 onwards. The individual policy classes followed a similar pattern.

For ordinary endowments (Graph 526) a reduction of 0.25% quickly and effectively compensated for the additional AIDS mortality, so that A/L ratios gradually rose to

almost 102% of the baseline by 2021. This pattern applied to both 10 and 25 year policies, but the increase above baseline ratios by 2021 was between 1% and 1.5% for 10 year policies, and between 3% and 4% for 25 year policies. A reduction of 0.5% more than compensated for the additional AIDS mortality.

5.4.8 Reduction of Bonus on Bonus

A reduction in the rate of reversionary bonus on bonus acted in the same way as a reduction in the rate of bonus on sums assured, but had a more gradual effect.

For low-cost endowments (Graph 527) overall A/L ratios are shown for reductions of 0.5%, 1.0% and 2.0%. The reduction of 2.0% compensated well for AIDS; the A/L ratio gradually improved from 96.5% of the baseline in 1993 to around 100% of the baseline from 2009 onwards. The individual policy classes followed a similar pattern.

For ordinary endowments (Graph 528) the overall A/L ratios for a reduction of 0.5% in the bonus rose above the baseline by almost 1% by 1997. Thereafter the ratios moved closer to the baseline ratios, falling slightly below by 2013. The patterns for individual policies were different. For 10 year policies, the ratios fell to around 0.1% below the baseline by 2001 and remained there. For 25 year policies, the ratios were always just above the baseline.

5.4.9 Reduction in the New Business Expansion Rate

Finally, a reduction in the rate of expansion of new business from 1989 was considered. This improves the A/L ratio by reducing the proportion of the business at shorter durations where there is new business strain, i.e. where asset shares do not yet exceed reserves.

For low-cost endowments (Graph 529), a reduction as large as 8% was required to restore the A/L ratio to 100% of the baseline by 2005, even though this corresponds to a level amount of new business from 1989.

For ordinary endowments (Graph 530) only 10 year policies were affected, as there was no expansion of 25 year policies after 1969. A 1% reduction almost offset the AIDS mortality up to 2005, and thereafter, the A/L ratios increased to around 103.6% of the baseline by 2021. This was mainly due to the A/L ratios for 10 year policies being about 104% of the baseline by 2021.

5.5 Conclusions

As would be expected, the effect of AIDS is considerably more severe on low-cost endowment business. This is perhaps brought out most clearly by considering the

changes in other factors which most nearly have an effect on the office's A/L ratios, at some future time, of the same magnitude as AIDS mortality on the Extended R basis.

For low-cost endowments :

	Change	Effect
(a)	Increase in gross yield on assets.	1% increase equivalent to the effect of AIDS by about 2009.
(b)	Reduction in per-policy expenses.	A 10% reduction had a minimal effect so reasonable improvements in expense efficiency would not be significant compared with AIDS.
(c)	Levy on asset shares of policies becoming claims.	Reducing the maturity benefit to about 92% of the asset share restores the A/L ratio to the baseline after about 30 years.
(d)	Levy on net rate of return credited to accumulating asset shares.	The effect of deducting 0.5% net builds up more slowly than (c) at first but restores the A/L ratio by about 2021.
(e)	Increase in premium rates.	Increasing the premium rates by 5% has a similar effect to that of (a), but is more effective in the short term and less effective in the long term.
(f)	Increase in valuation interest rate.	A 0.5% increase (from 3% to 3.5%) has an immediate effect on the A/L ratio of roughly the same magnitude as the introduction of AIDS, but is only half as effective in the longer term.
(g)	Improvement in valuation mortality table.	A change from A1967-70 to the 1979-82 experience has an effect much smaller than that of AIDS. More drastic changes were not tested.
(h)	Reduction in bonus on sums assured.	A 0.5% reduction (3% to 2.5%) has an effect comparable to that of AIDS by about 2005.
(i)	Reduction in bonus on bonus.	A 2% reduction (from 6% to 4%) has an effect comparable to that of AIDS by about 2009.
(j)	Reduction in rate of expansion of new business.	A reduction in the rate of expansion from 8% to nil would have an effect comparable to that of AIDS by about 2005.

For ordinary endowments :

Change	Effect
(a) Increase in gross yield on assets.	A 0.5% increase had an effect greater than that of AIDS at all durations.
(b) Reduction in per-policy expenses.	A 10% reduction had a minimal effect so reasonable improvements in expense efficiency would not be significant compared with AIDS.
(c) Levy on asset shares of policies becoming claims.	Reducing the maturity benefit by 1% to 99% of the asset share restores the A/L ratio to the baseline from 1989 onwards.
(d) Levy on net rate of return credited to accumulating asset shares.	A deduction of 0.1% net restored the A/L ratio to the baseline by about 1997.
(e) Increase in premium rates.	Increasing the premium rates by 5% increased the A/L ratios to above the baseline from 1997 onwards.
(f) Increase in valuation interest rate.	A 0.25% increase (from 3% to 3.25%) brought the A/L ratios very close to the baseline at all durations.
(g) Improvement in valuation mortality table.	A change from A1967-70 to the 1979-82 experience has an effect much smaller than that of AIDS. More drastic changes were not tested.
(h) Reduction in bonus on sums assured.	A 0.25% reduction (3% to 2.75%) had an effect at least as great as that of AIDS at all durations.
(i) Reduction in bonus on bonus.	A 0.5 reduction (from 6% to 5.5%) took the A/L ratios above the baseline for the first few years after the reduction was made. Thereafter the A/L ratios were very close to the baseline.
(j) Reduction in rate of expansion of new business.	A 1% reduction in the rate of expansion of 10 year endowments (from 8% to 7%) had an effect comparable to that of AIDS by about 2005. Note that the rate of expansion of 25 year endowments is nil.

6. TERM ASSURANCE

6.1   Introduction

Term Assurance is all about matching the premium basis to the experience which in turn is dependent on the level of underwriting. Before the appearance of AIDS the shape of the mortality curve was reasonably predictable and consequently margins in the premum rates could be, and were, reduced under pressure of competition. However margins may have been slightly higher than they appeared, because of the effect of steadily improving mortality. AIDS completely altered the position. Offices at first sought to protect themselves through underwriting alone, but by 1989 premiums had also increased significantly throughout the industry. Following the advice of the IAWP [2], many offices appeared to be using the B/C basis, which in the light of more recent evidence seems too heavy to represent the spread in the homosexual population alone, and the wrong shape to represent more general spread.

6.2   Premiums for Term Assurance

The policies chosen were level term assurances of terms 10 and 25 years on male lives aged 30, 40 and 50 at entry.

We suppose that offices will recalculate their premium rates from time to time, as more is learned about AIDS mortality, so we have assumed in our projections that the AIDS mortality basis used for premium rating closely follows that in the experience. In this section we show how premiums calculated using different AIDS mortality tables would vary over time.

The premium basis is given in Appendix 2, and Graphs 601 to 606 show the term assurance rates for these policies as recalculated every 5 years from 1984, on bases F, R and Extended R.

The rates on bases F and R are remarkably similar, given that the additional mortality for AIDS differs considerably at the older ages; those on basis R are only slightly lower. The greatest effect is on young lives and the shorter term, a consequence of the higher expected incidence of AIDS at younger ages.

6.3   Asset/Liability Ratios for Term Assurance Business

We examined the effect on the A/L ratios of varying the AIDS mortality in the premium and valuation bases. As in Section 5, the "A" in the "A/L" refers to the assets generated by the term assurance business alone, and does not include any surplus assets

which may exist elsewhere in the office. This measure shows rather more variability for term assurance business than for with-profit business, so the results are not directly comparable. We did not find it as easy to combine the term assurance contracts at different ages and terms and hence there are no "overall A/L ratios" such as were used in Section 5.

Term assurance business has small reserves, so the A/L ratio may seem to be an unnatural measure to choose. Our main reason for using it was for consistency with the combined office projections in Section 7, where the A/L ratio of the term assurance business is a component of the A/L ratio for the whole office.

6.3.1 The effect of changing the premium rates

In looking at with-profit business in Section 5, we assumed that premium rates were not changed, as the terminal bonus was available to absorb the additional cost. Clearly this is not possible for term assurance, so we considered the effects of

(a)   changing the premium rates for new business in 1989 to include the additional AIDS mortality projected from that time, or

(b)   changing the premium rates for new business in 1989 and every 5 years thereafter.

Graphs 607 and 608 show the resulting A/L ratios for lives aged 30 at entry, for terms 10 years and 25 years respectively, assuming AIDS mortality on basis R, and Graphs 609 and 610 show similar ratios on the Extended R basis. The results for the other ages at entry followed a similar pattern. Six sets of assumptions are shown in each graph.

The Baseline assumes : No AIDS mortality, no change in premium rate and no change in valuation basis.

(1)   AIDS mortality in the experience only, no change in premium rates or in the valuation basis. This shows the "worst case" and is included to show how effective the following changes are in stopping the decline. Note that all the following changes include a component of this case because of business written before 1989.

(2)   AIDS mortality in the experience and in the premium rates, but not in the valuation basis. The premium rate is recalculated in 1989 and is not changed thereafter.

(3)   As in (2), with in addition AIDS mortality being introduced into the valuation factors, but not the valuation net premiums, from 1989.

(4)   AIDS mortality in the experience, and in the premium rates. The premium rate is recalculated in 1989 and every 5 years thereafter. AIDS mortality is also introduced into the valuation factors in 1989, but is excluded from the valuation net premiums.

(5)   As in (3), but with AIDS mortality included in the valuation net premiums.

(6)   As in (4), but with AIDS mortality included in the valuation net premiums.

Note that both the inclusion and the exclusion of AIDS from valuation net premiums for the whole in-force are extreme positions, neither completely justified. In practice, it would be reasonable to exclude AIDS from the valuation net premiums of business written before the premium rates were changed, and include it for business written subsequently. However, the cases shown do allow the effect of such intermediate courses of action to be judged. Note that where AIDS is included in the valuation net premium, the net premium is recalculated as at the date of entry of the policy.

All the graphs show the expected fall if no changes are made to premium rates, and for Basis R there is a recovery after the peak of deaths in the homosexual population is passed; clearly no such recovery is to be expected on the Extended R basis.

If the premium rates are changed only in 1989, and not thereafter, then on Basis R they become extremely profitable after the end of this century, but on the Extended R basis they become inadequate after 1989.

Changing the premium rates every 5 years more or less removes both the ultimate profit under Basis R and the ultimate losses under the Extended R basis. This illustrates the extent to which offices may have to pay attention to the developing experience of AIDS and pursue an active premium rating policy in future; even in the current circumstances premium rates are already being reduced by some offices.

In general, the only cases in which the baseline (no AIDS) A/L ratios are eventually attained or surpassed are on basis R with the premium rate changed in 1989 only. In the other cases, the losses made on business written before 1989 are never recovered.

6.3.2 Comparing the effect of different AIDS assumptions

The comparisons in each graph described above each assume a single AIDS

mortality table. In Graphs 611 to 616, we show the A/L ratios for a single policy class with no AIDS (the baseline projection), and with AIDS mortality on bases F, R and Extended R, as follows.

Graph 611 Term 10 years, age 30 at entry

Graph 612 Term 25 years, age 30 at entry

Graph 613 Term 10 years, age 40 at entry

Graph 614 Term 25 years, age 40 at entry

Graph 615 Term 10 years, age 50 at entry

Graph 616 Term 25 years, age 50 at entry

In each case, the premium rates were changed in 1989 and then every 5 years thereafter, and AIDS mortality was allowed for in the valuation factors and in the valuation net premiums.

6.4   Sensitivity Tests

We carried out sensitivity tests similar to those described in Sections 4 and 5.4. Throughout these tests, we assumed that AIDS mortality on the Extended R basis was introduced into the experience in 1984 and into the valuation basis in 1989. AIDS mortality was excluded from the valuation net premiums. Premium rates were recalculated in 1989 and every 5 years thereafter.

The tests were:—

(a)   A 2% increase in gross gilt redemption yields from 1989.

(b)   A reduction of 40% in per-policy expenses from 1989.

(c)   An increase in the valuation rate of interest from 5% to 6% in 1989.

(d)   A change in the valuation non-AIDS mortality from A1967-70 ult. to the CMI 1979-82 experience, from 1989.

(e)   A change in the new business rate of expansion from 8% to 4% from 1989.

None of the changes matched the cost of AIDS death claims at all well, and all gave similar results, namely little effect on policies on lives aged 30 at entry, whose A/L ratios remained well below the baseline, and a considerable effect on policies on lives aged 50 at entry, whose A/L ratios quickly exceeded the baseline. The explanation lies

in the relative insignificance of AIDS mortality, compared with normal mortality, at the older ages. In addition, and except for the change to the new business rate of expansion, the 10 year policies, with very small reserves, were much less sensitive to the changes than were the 25 year policies, with much larger reserves.

6.5   Conclusion

The sensitivity tests were less successful in quantifying the cost of AIDS for term assurance business than they were for with-profit business, because the effect of AIDS is so variable with age and the nature of the reserves is rather different for policies of different terms. These tests will be fairly specific to any given portfolio of liabilities, such as will be considered in Section 7.

7.   THE COMBINED OFFICE

7.1   Given the differing effect of AIDS on different policy types, it is clear that the overall effect of AIDS on any office will depend on that office's mix of business. We therefore set up a model containing a mix of endowment assurances, low-cost endowment assurances and term assurances, and repeated certain of the investigations carried out before.

7.2   We chose a set of assumptions which resulted in an office with the following broad features:

(a)   From 1949 to 1969 there were three markets, for long term savings (repre- sented by 25 year endowments), for short term savings (represented by 10 year endowments) and for protection (represented by 10 and 25 year term assurances).

(b)   From 1969 there was no growth in 25 year endowment premium income as low-cost endowments took over the long term savings market.

(c)   Low-cost endowment premium income grew very rapidly during the mort- gage boom in the 1980s, and consequently low-cost business dominated the office thereafter.

(d)   Short term savings and term assurance business grew steadily throughout.

We were aware that the range of possible assumptions was very wide, and that by choosing a single set we were perhaps narrowing the focus of our investigation too much. Had it not been our intention to make the computer model available, we might have preferred not to pursue this line, but since it is possible for others to widen the

scope of the investigation themselves, we felt free to explore particular cases by way of example.

7.3 The office was assumed to write the following policies:

10 year endowments	Ages 40 and 50 at entry
25 year endowments	Ages 30 and 40 at entry
25 year low-cost endowments	Ages 30 and 40 at entry
10 year term assurances	Ages 30 and 50 at entry
25 year term assurances	Ages 30 and 40 at entry

The weighting given to each line of business results from the new business premium defined when the office was set up in 1949 (or for low-cost endowments, 1969) and on the subsequent new business expansion. The starting amounts of new business premiums defined in 1949 (1969 for low-cost endowments), and the amounts of new business premium being written in 1989, were as follows:

	New Business Premiums written in	
Policy	1949 (or 1969)	1989
	£000	£000
10 year Endowments	67.63	1469.33
25 year Endowments	67.63	315.24
Low-cost Endowments	406.17(in 1969)	7849.16
10 yr Term	9.02	195.91
25 yr Term	22.54	489.78

The rates of new business expansion assumed were the same as in Sections 5 and 6.

The breakdown of the published reserves after 1981 if the office is projected forward with no AIDS mortality clearly reflects the rapid rise of low-cost business in the savings market, as follows:

Year	Endowment	Low-cost	Term
1981	64.2%	26.5%	9.3%
1989	31.7%	62.7%	5.6%
1997	9.6%	87.9%	2.5%
2005	3.8%	94.7%	1.5%
2013	2.3%	96.6%	1.1%

This particular office passes through two distinct periods; one before the year 2000 during which term assurance business may, despite its low and relatively decreasing quantity, have a measurable effect because of its much greater sensitivity to AIDS, and one after the year 2000 during which the office behaves almost as if there were no business except low-cost endowments.

7.4   As in Section 5, we chose A/L ratios as an interesting financial measure to examine. In Section 5 we also examined the possible effect of AIDS on the terminal bonuses of with-profit business. The terminal bonus rates for policies in the combined office are the same as those for the corresponding policies shown in Section 5, because the model assumes that there is no cross-subsidy of terminal bonuses between policy classes.

7.5   Baseline Projections

In the absence of AIDS (Graph 701), the baseline A/L ratios peaked at roughly 1.37 in 1989, and then declined to about 0.98 by 2001 and stayed at that level. In the absence of an external estate, such an office would of course cease trading, or more likely would have to reduce its reversionary bonus rates. We did not regard it as particularly relevant for the purposes of this investigation to give the office extra assets or to adjust bonus rates, given that terminal bonuses remained reasonably high until well after the year 2000.

7.6   Effect of AIDS Projections R and Extended R

7.6.1 Graph 701 shows the effect of AIDS mortality assuming that no adjustments are made either in the calculation of asset shares or in premium rates or in the valuation bases. In other words, the cost of AIDS mortality is borne entirely by the estate.

7.6.2 For Graph 702 we recalculated term assurance premium rates every 5 years, starting in 1989, using the same AIDS mortality as is actually experienced. The A/L ratios fell to 0.958 (97.4% of the baseline) by 2001, then recovered slightly under basis R, or declined slowly under Extended R. The effect of correctly anticipating the AIDS mortality in term assurance premium rates was to improve the A/L ratio by roughly 0.5%.

7.6.3 For Graph 703 term assurance premium rates were recalculated as above, and "Method 2" of Section 4.4 was employed (i.e. AIDS death claims were allowed for in the calculation of asset shares). Most of the direct cost of AIDS was therefore

ultimately transferred from the estate to the policyholders. The A/L ratios in fact differed hardly at all from those in which AIDS was ignored in the asset shares until about 2010, since the office only recovered the extra cost of AIDS deaths from maturing with-profit policies, and the bulk of the with-profits business was of very long term and short average duration.

7.6.4 In Graph 704 we assumed, in addition to the above, that the same AIDS mortality as was actually experienced was included in the valuation basis from 1989 onwards, and that AIDS mortality was allowed for in the calculation of valuation factors but not in the valuation net premiums. It may not be appropriate to assume that AIDS may be allowed for in valuation net premiums if it was not allowed for in office premiums. The A/L ratios fell by 1993 to 1.146 (95% of the baseline) on basis R, and 1.134 (94% of the baseline) on Extended R. On basis R, the A/L ratio then very gradually recovered, while on Extended R it continued to worsen so that by 2001 it was 0.916 (93% of the baseline).

7.6.5 Graph 705 is as above except that AIDS was allowed for in all valuation net premiums. The immediate effect on the A/L ratio was a reduction to 1.188 (98% of the baseline) by 1993 on basis R, and to 1.185 on Extended R. On basis R, the A/L ratio remains 2% to 2.5% below the baseline and only gradually begins to recover after about 2010. On the Extended R basis the A/L ratio declined steadily and more rapidly than the baseline, so that by 2017 it was 0.942 (95% of the baseline).

7.6.6 The position as represented in 7.6.4 above is slightly harsher than is justified, since it would be appropriate to allow for AIDS in term assurance valuation net premiums for business written from 1989 onwards. We investigated the effect of doing so, and found that the A/L ratio was improved by about 0.3%. Under basis R, the effect had worn off by about the year 2005. Due to the small proportion of term assurance business, and the limitation of the net premium, there was no measurable difference if we allowed for AIDS in the valuation net premiums for all term assurance business from 1989 onwards, and in the sensitivity tests which follow we adopted this assumption for simplicity.

7.6.7 The following table shows the percentage changes in the reserves in 1989 immediately following the changes to the valuation basis outlined in 7.6.6 above.

Percentage Change in Reserves on changing valuation basis in 1989

AIDS Mortality Table	AIDS in Valuation Factors only	AIDS in Valuation Factors and Net premiums
R	+4.6%	+2.0%
Extended R	+5.1%	+2.2%

7.7   Sensitivity Tests

7.7.1 The sensitivity tests were carried out using the Extended R basis in the experience, in the calculation of the asset shares, and from 1989 in all valuation factors and in the valuation net premiums of all term assurance business. This and the projection with no AIDS mortality at all are shown in all the graphs referred to below. The graphs start at 1989 because the A/L ratios are not changed before that year.

To show the extent to which the change being tested is comparable with the effect of AIDS mortality, the following table shows the A/L ratios both on the baseline projection with no AIDS mortality, and on the projections using the Extended R basis described above.

A/L Ratios

Year	(1) *No AIDS*	(2) *Extended R*	(2) *as a percentage of (1)*
1989	1.337	1.337	100.0%
1993	1.210	1.138	94.0%
1997	1.049	0.982	93.6%
2001	0.983	0.919	93.5%
2005	0.981	0.917	93.5%
2009	0.988	0.923	93.4%
2013	0.990	0.922	93.1%
2017	0.989	0.918	92.8%

7.7.2 Graph 706 shows the effect of a 0.5% and a 1.0% increase in the gross redemption yields on gilts and gross dividend yields, from 1989 onwards. The 1.0% increase did restore the A/L ratios to the baseline, but not before 2009. In large part, this is because the increased income did not remain in the estate but was passed on to policyholders via increased maturity values. The effect on an office which had free assets other than accrued terminal bonuses would be different.

7.7.3 Graph 707 shows the effect of reducing terminal bonuses on death or maturity by

(a)   calculating claim values including terminal bonus as 95% of asset shares (instead of 100%), or

(b)   deducting 0.5% from the net rate of return credited to accruing asset shares,

both changes being made from 1989 onwards. Neither restored the A/L ratios to the baseline.

7.7.4 Graph 708 shows the effect of weakening the valuation bases described above. Increasing the valuation interest rates by 1% (with-profit to 4% and non-profit to 6%) largely cancelled out the immediate cost of the allowance for AIDS in the valuation, but did not affect the depletion of assets caused by the AIDS death claims. Changing the valuation mortality from A1967-70 ultimate to the CMI 1979-82 experience was worth no more than 1% to 1.5% on the A/L ratio.

7.7.5 Graph 709 shows that a reduction of 0.5% (from 3% to 2.5%) in the rate of bonus on sums assured from 1989 onwards eventually restored the A/L ratios to slightly better than the baseline, and furthermore had a significant effect before the year 2000. A reduction of 0.25% is also shown in the graph. Graph 710 shows that a 2% reduction was needed in the rate of bonus on bonus (from 6% to 4%) to achieve roughly the same effect over the same timescale.

7.7.6 Graph 711 shows that reducing the rate of growth of new business from 8% to nil (except for 25 year ordinary endowments, for which the rate of growth was nil anyway) would restore the A/L ratios to the baseline eventually, but this ignores the other consequences of such an action.

7.7.7 In view of the importance of the sums at risk under low-cost endowments, it might be expected that changes in the proportion of the low-cost death benefit which is provided by the endowment assurance would have a measurable effect. Graph 712 shows the effect of not changing the low-cost endowment premium rates in 1984, so that the endowment policy provided 43.2% of the low-cost death benefit at the outset, instead of 39.6%. This is in line with the magnitude of the changes made by offices from time to time. Although the absolute effect was small, (an addition of about 0.5% to the A/L ratio), it represents considerable sensitivity to quite a small change.

7.7.8 Moderate reductions in expenses, of 10% of per-policy expenses or 20% in commission related expenses, had a small effect, of not more than 0.6% of the A/L ratio. (These ratios are not graphed).

7.8   Conclusions

The following is a summary of the changes in other factors which most nearly have an effect on the office's A/L ratios, at some future time, of the same magnitude as AIDS mortality on the Extended R basis.

Change	Effect
(a) Increase in gross yield	A 1% increase was equivalent to the effect of AIDS on assets by about 2009. A 0.5% increase had about half the effect.
(b) Reduction in per- policy expenses.	A 10% reduction had a negligible effect compared with AIDS. Larger improvements were not tested.
(c) Levy on asset shares of policies becoming claims.	Basing maturities on 90% of the asset share had an effect on the A/L ratios of the same magnitude as AIDS by about 2013.
(d) Levy on net rate of return credited to accumulating asset shares.	The effect of deducting 1% net built up more slowly than (c) at first but was also similar to the effect of AIDS by about 2013.
(e) Decrease in term assurance portion of low-cost endowment business.	Increasing the endowment sum assured from 39.6% to 43.2% of the guaranteed death benefit increased the A/L ratio by about 0.5% throughout.
(f) Increase in valuation interest rate.	A 1% increase nearly cancelled out the increases in reserves in the short term but was only half as effective in the longer term.
(g) Improvement in valuation mortality table.	A change from A1967-70 to the 1979-82 experience had an effect much smaller than that of AIDS. A change to 50% of A1967-70 was similar. More drastic changes were not tested.
(h) Reduction in bonus on sums assured.	A 0.5% reduction (from 3% to 2.5%) had an effect comparable to that of AIDS by about 2009. A 0.25% reduction had about half the effect.
(i) Reduction in bonus on bonus.	A 2% reduction (from 6% to 4%) had an effect comparable to that of AIDS by about 2009. A 1% reduction had about half the effect.
(j) Reduction in rate of expansion of new business.	A rate of expansion of nil had an effect comparable to that of AIDS by about 2009.

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APPENDIX 1

BARCLAYS DE ZOETE WEDD INDICES

Year	Rate of Retail Price Inflation	Gross Dividend Yield	Rate of Increase in Equity Prices	Gross Redemption Yield on Gilts
1949	2.9%	5.0%	—10.3%	3.5%
1950	2.5%	5.0%	5.6%	3.5%
1951	12.2%	5.4%	3.0%	4.0%
1952	3.0%	6.1%	—5.9%	4.2%
1953	0.2%	5.4%	17.8%	3.9%
1954	3.3%	4.4%	42.4%	3.8%
1955	5.1%	4.8%	5.8%	4.4%
1956	2.2%	5.7%	—13.9%	4.7%
1957	4.3%	6.3%	—7.0%	5.3%
1958	1.6%	4.8%	41.1%	4.8%
1959	NIL	3.6%	49.5%	5.0%
1960	1.8%	4.5%	—2.6%	5.6%
1961	3.8%	4.8%	—3.0%	6.5%
1962	2.3%	5.0%	—4.4%	5.4%
1963	1.9%	4.1%	14.8%	5.5%
1964	4.8%	5.2%	—10.6%	6.1%
1965	4.6%	5.2%	6.8%	6.2%
1966	3.7%	5.9%	—10.8%	6.4%
1967	2.4%	4.2%	32.5%	6.9%
1968	5.9%	3.4%	37.0%	7.6%
1969	4.8%	4.0%	—15.1%	8.5%
1970	7.8%	4.6%	—6.2%	9.3%
1971	9.0%	3.4%	40.5%	8.3%
1972	7.6%	3.1%	18.1%	9.6%
1973	10.6%	4.4%	—34.9%	11.9%
1974	19.2%	11.8%	—54.7%	17.0%
1975	24.9%	5.7%	136.1%	14.8%
1976	15.1%	7.4%	—7.9%	15.0%
1977	12.1%	5.4%	49.1%	10.9%
1978	8.4%	5.6%	6.1%	13.2%
1979	17.2%	6.8%	2.7%	14.7%
1980	15.1%	5.8%	26.7%	13.9%
1981	12.0%	5.9%	6.0%	15.8%
1982	5.4%	5.2%	22.4%	11.1%
1983	5.3%	4.7%	22.7%	10.5%
1984	4.6%	4.5%	24.2%	10.6%
1985	5.7%	4.2%	16.7%	10.5%
1986	3.7%	4.1%	21.4%	10.5%
1987	3.7%	4.4%	3.8%	9.5%

APPENDIX 2

PREMIUM BASES AND RATES

A2.1 We calculated hypothetical but "typical" premium rates on the following basis.

Mortality	A67/70 select—1 year
Interest	5% net
Bonus Loading	2.5% (needed for endowments and term assurance portion of low-cost endowments)
Commission	100% of LOA scale
Initial Expenses	£40 plus 50% of initial commission
Renewal Expenses	Assumed equivalent to a level policy fee
Tax Relief	35%

A2.2   The policy fee was £10 per year.

A2.3   The fixed initial expense and policy fee were chosen to be roughly appropriate in 1984. However, the premium rates were valid at all times because

(a)   the fixed initial expenses and policy fees used to set up the model in 1949 were the above figures deflated by the change in RPI, and

(b)   The fixed initial expense, policy fee and average premium were all linked to RPI in the model.

A2.4   There were no renewal expenses in the premium basis because these were supposed to be covered by the policy fee. This is preferable for a basis which has to cover term assurances, since these will be more sensitive to expenses than with-profit business. There were, of course, renewal expenses in the model.

A2.5   Changes in tax and commission were ignored in the premium rate calculations. The only changes made to premium rates were for term assurances, to allow for the effect of AIDS, and to low-cost endowments, to allow for changes in reversionary bonus rates.

A2.6   The bonus assumption for calculating low-cost endowment premiums was 80% of the amount of bonus at maturity assuming continuation of the most recently declared bonus rates (see Section 3), resulting in the following endowment sums assured per mille of guaranteed death benefit.

1969-78	384 per mille
1979-83	396 per mille
1984-	432 per mille

A2.7   The premium rates calculated as above are shown in the following table. We also show, for comparison, premium rates suitable for use in 1989, loaded for AIDS mortality on the Extended R basis.

Policy	Age	Term	Rate per mille (No AIDS)	Rate per mille, loaded for AIDS, Extended R Basis
Endowment	30	10	102.70	102.90
	40	10	103.20	103.40
	50	10	105.30	105.30
Endowment	30	25	40.20	40.80
	40	25	42.00	42.50
	50	25	47.40	47.60
Low-cost	30	25	16.19	16.82
Endowment	40	25	18.37	18.86
(1969-78)	50	25	24.50	24.68
Low-cost	30	25	16.64	17.26
Endowment	40	25	18.77	19.28
(1979-83)	50	25	24.81	24.99
Low-cost	30	25	17.99	18.59
Endowment	40	25	20.00	20.49
(1984-)	50	25	25.76	25.93
Level Term	30	10	1.00†	1.50
	40	10	2.39	3.02
	50	10	7.55	7.76
Level Term	30	25	1.84	2.74
	40	25	5.49	6.16
	50	25	15.01	15.22

† The calculated rate was 0.84 but a minimum premium rate of £1.00 per mille was assumed.

APPENDIX 3

ACTIONS TAKEN BY OFFICES TO CONTROL THE COST OF AIDS MORTALITY

A3.1   This appendix describes briefly some of the steps taken by life offices to control the additional cost of AIDS mortality through underwriting, product design and premium rating.

A3.2   Proposal forms have been amended to include a question which covers AIDS, usually as one among several diseases. The wording varies from office to office, but the following example is typical.

> "Have you had or been advised to have any counselling or investigation in connection with AIDS, Hepatitis B or any sexually-transmitted disease?"

A3.3   Supplementary questionnaires (sometimes called "life style" question-naires) may be issued if sums assured exceed certain limits, generally lower than the limits at which a private medical attendant's report would be required. The following example is typical of the information requested.

> "State YES or NO to the following and if YES give full details
>
> Do you belong or have you ever belonged to one of the following AIDS high-risk groups established by the health authorities
>
> (a) homosexual men
>
> (b) bisexual men
>
> (c) intravenous drug users
>
> (d) haemophiliacs
>
> (e) sexual partners of the preceding groups"

The limits of sum assured at which supplementary questionnaires are required may depend on age, type of policy and marital status. Typical limits are in the range £10,000—£30,000 for single men and around £75,000 for married men. The following limits are applied by two offices but they may be taken as typical of larger offices with high retention limits.

Office A

	Low premium (eg term assurance)	High Premium (eg endowments)
Single men	£30,000	£75,000
Married men	£200,000	£200,000

Office B

Single men up to age 60	£25,000
Married men up to age 60	£150,000

A3.4   In addition, HIV blood tests may be required for higher sums assured, typically £150,000—£250,000 for single men and £250,000—£500,000 for married men.

A3.5   Non-medical underwriting limits have not necessarily fallen, but increases which would otherwise have taken place have not been implemented.

A3.6   A number of offices have introduced AIDS exclusion clauses into

(a)   PHI business

(b)   waiver of premium benefit

(c)   continuation options under group life schemes.

A3.7   Options to increase sums assured, or to extend the term of life cover, without evidence of health, have been curtailed. These include the increase options which were common under unit-linked whole life plans, and increasable, renewable term contracts.

A3.8   Almost all offices have increased premium rates under term assurances and other contracts with high levels of life cover. The form of these increases has varied widely from office to office; further it is clear that many offices took the opportunity of revising their premium bases more generally, for factors other than AIDS mortality. Thus the change in an office's premium rates is not a reliable guide to the basis in use. An extensive survey was carried out by a large reinsurer at the end of 1988 [14].

A3.9   There is no evidence to date of any widespread changes being made to with-profit premium rates to allow for possible AIDS mortality.

A3.10   Many offices which write unit-linked or unitised with-profit policies under which death benefits are paid for by cancelling units have increased these charges. It is usual for policy conditions to allow these changes to be applied to in-force business as well as new business, subject to some period of notice.

APPENDIX 4

DESCRIPTION OF THE COMPUTER MODEL

A4.1   The program, called "MO", is a general purpose model of a with-profits office, suitable for a wide range of research or education work. From the outset, we decided that it would be useful if such a model were to be made more widely available, for two reasons.

(a)   The authors of any paper have to choose a small range of assumptions. Others will disagree with their choice, but having no access to the model they are at a disadvantage in discussion. A program such as "MO" may help to restore the balance.

(b)   The model may stimulate research by others who lack the time or the inclination for the complex task of constructing a model.

This appendix describes the main features of the program. It is not a user manual. Detailed notes are provided with the program disks

A4.2   One major aim of the model is to permit the user to configure it to model realistic combinations of
net and gross business
with and without profit business
policy types
policy terms and ages at entry

The program views an office as a hierarchy with the whole office at the top and policies at the bottom. Apart from this, the structure is not fixed. Rather, there is a pool of building blocks called "classes" which can be selected and combined by the user to set up any desired hierarchy. The classes, in descending order in the hierarchy, consist of tax funds (eg net and gross), business funds (eg with-profit or non-profit), policy classes (eg endowments) and individual policy types (eg n year endowments for lives aged x). The only demand made by the model is that these components are assembled in a sensible order.

There is plenty of scope for future development. For example, it is relatively simple to add new policy types, by adding new classes. Alternatively, by inserting an extra layer it would be possible to model mergers, demergers and subsidiaries.

A4.3   As far as possible, each of the classes which represent an office is independent of all other classes on the same level or higher levels. In particular, each has its own fund of assets whose distribution, income and tax are independent of the assets held elsewhere in the office. One way of looking at this is that each branch of

the office is treated as a small free-standing office in its own right. This treatment is applied consistently at every level, so that at the very bottom, a single policy may be isolated from every other policy. As a result, cross-subsidies between two or more policies or branches of the office emerge as profits or losses at a higher level (namely that level at which the policies or branches are combined).

A4.4 Unvarying conditions are not very interesting. On one hand, offices operate in a very fluid environment which is outside their control, and on the other hand managements react by adjusting those factors which are under their control.

The running of the model is controlled by sets of parameters defining both the operating environment and the actions of the management. The necessary flexibility is given in three ways.

(a)   Every set of parameters is configurable by the user. The model imposes a bare minimum of "sensibleness" checks.

(b)   Every set of parameters can be set up to vary over time.

(c)   Each of the classes possesses its own independent set of parameters, appropriate to its level in the hierarchy. For example, each tax fund possesses a set of tax parameters, and each policy class possesses a set of valuation bases. Hence the parameters are linked to the hierarchy which the user has set up, in such a way that different branches of the office can be "managed" independently.

The parameters cover the following.
> Investment conditions
> Investment models
> Taxation and tax relief
> Investment strategies
> Bonus rates and strategies
> Published valuation methods and bases
> Statutory minimum valuation methods and bases
> Solvency Margins
> Mismatching tests
> Expenses and Commission
> Surrender value bases
> Unit charges
> Premium rates
> New Business
> Deaths (including AIDS mortality)
> Surrenders
> Equity backing strategies
> Asset transfers within and without the office

A4.5   Simplicity of input is helped by fairly intuitive menus and screens. Understanding the output demands rather more of the user. Documentation of assumptions and algorithms is provided, but some prior actuarial knowledge must be assumed. More important, the user must be aware of the ways in which the hierarchical structure of the office affects the results.In our experience, the use of the model has to be learned, and it is not necessarily straightforward to interpret the outputs. In particular, experience helps to spot when an "interesting" result is really caused by an error in the inputs. However, it is fair to point out that we did much of our work before the documentation was complete.

A4.6   The model runs on IBM compatible microcomputers, with a minimum configuration of

IBM XT or compatible (8086/88 chip)
        512K memory
        2 x 360K or 1 x 720K floppy disk drives
        MS-DOS 2.0 or higher

However, a maths coprocessor, hard disk and faster chip (80286, 80386 or 80486) are strongly recommended.

A4.7   The program has been written in C with a view to porting it to different hardware (including Transputers) or operating systems (in particular, Unix and OS/2).

A4.8 It is intended to continue to develop the program, by adding more classes and removing restrictions. Initially, this means that it is better not to distribute the source code, which would probably be incomprehensible to anyone but the author anyway. One possibility, yet to be explored, is to provide the database and screen libraries in object code form, with a set of skeleton modules into which a user could insert suitable calculations. For this purpose, it may be worthwhile using the object-oriented capabilities of C++.

Graph 501

Baseline A/L ratios for Low - Cost Endowments

Graph 502

Baseline A/L ratios for Ordinary Endowments

Graph 503

Baseline Terminal Bonus Rates for Low - Cost Endowments

30:25 40:25 50:25

Graph 504

Baseline Terminal Bonus Rates for Ordinary Endowments

30:10 40:10 50:10 30:25 40:25 50:25

Graph 505

A/L ratios for Low-Cost Endowments;
AIDS death claims are not deducted from Asset Shares.

Graph 505a

Assets and liabilities with AIDS mortality on Extended R in the experience
as a proportion of those under the baseline projection for low-cost endowments

Graph 506

A/L ratios for Ordinary Endowments;
AIDS death claims are not deducted from Asset Shares.
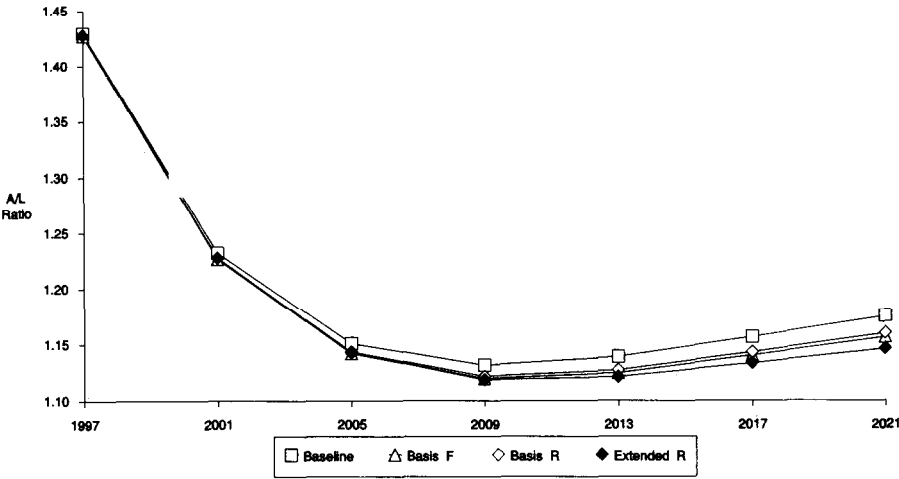
Graph 506a

Assets and liabilities with AIDS mortality on Extended R in the experience
as a proportion of those under the baseline projection for ordinary endowments

Graph 507

A/L ratios for Low-Cost Endowments;
AIDS death claims are deducted from Asset Shares.

Graph 508

A/L ratios for Ordinary Endowments;
AIDS death claims are deducted from Asset Shares.

Graph 509

Emerging terminal bonus rates as a percentage of baseline rates
for a 25 year low-cost endowment issued to a forty year-old.

△ Basis F   ◇ Basis R   ◆ Extended R

Graph 510

Emerging terminal bonus rates as a percentage of baseline rates
for a 25 year ordinary endowment issued to a forty year-old.

△ Basis F   ◇ Basis R   ◆ Extended R

Graph 511

Emerging terminal bonus rates as a percentage of baseline rates
for a 10 year ordinary endowment issued to a forty year-old.

| △ Basis F | ◇ Basis R | ◆ Extended R |

Graph 512

A/L ratios for Low - Cost Endowments:
AIDS mortality in valuation bases from 1989;
AIDS death claims are deducted from Asset Shares.

| □ Baseline | △ Basis F | ◇ Basis R | ◆ Extended R |

Graph 513

Sensitivity Test for Low - Cost Endowments:
Addition of 0.5%/1% to gross yields from 1989

Graph 514

Sensitivity Test for Ordinary Endowments:
Addition of 0.5% to gross yields from 1989

Graph 515

Sensitivity Test for Low - Cost Endowments:
Maturities and Claims based on 95%/90% of Assetshares from 1989

Graph 516

Sensitivity Test for Ordinary Endowments:
Maturities and Claims based on 95%/99% of Assetshares from 1989

Graph 517

Sensitivity Test for Low - Cost Endowments:
Net rate of interest accruing to Assetshares is reduced by 0.5% from 1989
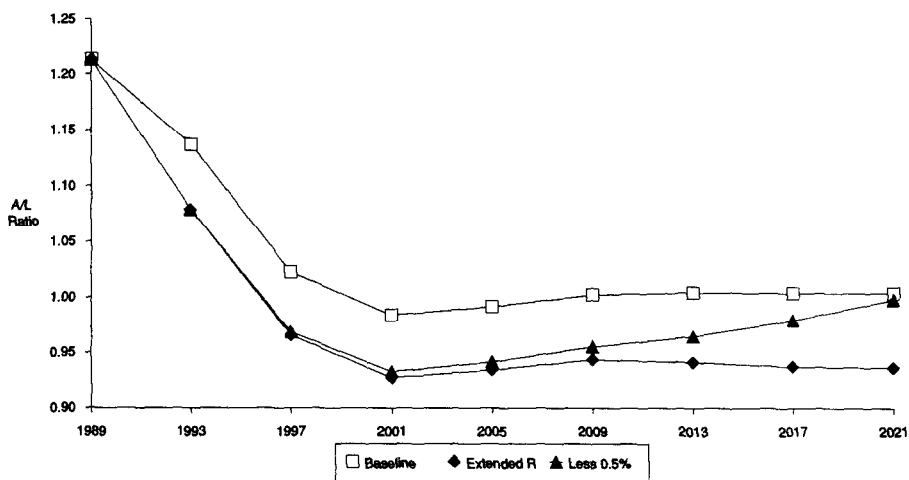
Graph 518

Sensitivity Test for Ordinary Endowments:
Net rate of interest accruing to Assetshares is reduced by 0.5% / 0.1% from 1989

Graph 519

Sensitivity Test for Low - Cost Endowments:
Premium rates are increased by 5% from 1989

Graph 520

Sensitivity Test for Ordinary Endowments:
Premium rates are increased by 5% from 1989

Graph 521

Sensitivity Test for Low - Cost Endowments:
Valuation interest rate is increased from 3% to 3.25%/3.5% from 1989

Graph 522

Sensitivity Test for Ordinary Endowments:
Valuation interest rate is increased from 3% to 3.25% from 1989

Graph 523

Sensitivity Test for Low - Cost Endowments:
Valuation non-AIDS mortality from 1989 is the CMI 1979-82 experience

Graph 524

Sensitivity Test for Ordinary Endowments:
Valuation non-AIDS mortality from 1989 is the CMI 1979-82 experience

Graph 525

Sensitivity Test for Low - Cost Endowments:
Reversionary bonus on Sums Assured is reduced from 3% by 0.25%/0.5% from 1989

Graph 526

Sensitivity Test for Ordinary Endowments:
Reversionary bonus on Sums Assured is reduced from 3% by 0.25%/0.5% from 1989

Graph 527

Sensitivity Test for Low - Cost Endowments:
Reversionary bonus on bonus is reduced from 6% by 0.5%/1%/2% from 1989

A/L Ratio

| □ Baseline | ◆ Extended R | ▲ 0.5% reduction | △ 1% reduction | ◇ 2% reduction |

Graph 528

Sensitivity Test for Ordinary Endowments:
Reversionary bonus on bonus is reduced from 6% by 0.5% from 1989

A/L Ratio

| □ Baseline | ◆ Extended R | ▲ 0.5% reduction |

Graph 529

Sensitivity Test for Low - Cost Endowments:
Expansion rate is reduced by 8% from 1989

Graph 530

Sensitivity Test for Ordinary Endowments:
Expansion rate is reduced by 1% to 7% from 1989 for 10 year policies

Graph 601

Term Assurance Premium Rates:
10 year term for a male aged 30.

Graph 602

Term Assurance Premium Rates:
25 year term for a male aged 30.

Graph 603

Term Assurance Premium Rates:
10 year term for a male aged 40.

Term Assurance Premium Rates:
10 year term for a male aged 40.

■ Baseline   □ Basis F   ▨ Basis R   ▨ Extended R

Graph 604

Term Assurance Premium Rates:
25 year term for a male aged 40.

■ Baseline   □ Basis F   ▨ Basis R   ▨ Extended R

Graph 605

Term Assurance Premium Rates:
10 year term for a male aged 50.

| ■ Baseline | ☐ Basis F | ▨ Basis R | ▨ Extended R |

Graph 606

Term Assurance Premium Rates:
25 year term for a male aged 50.

| ■ Baseline | ☐ Basis F | ▨ Basis R | ▨ Extended R |

Graph 607

A/L Ratios for 30:10 Term Assurances on Basis R
(refer to text for legend)

Graph 608

A/L Ratios for 30:25 Term Assurances on Basis R
(refer to text for legend)

Graph 609

A/L Ratios for 30:10 Term Assurances on Extended R
(refer to text for legend)

Legend: □ Baseline   ◇ (1)   △ (2)   ■ (3)   ◆ (4)   ✕ (5)   ▲ (6)

Graph 610

A/L Ratios for 30:25 Term Assurances on Extended R
(refer to text for legend)

Legend: □ Baseline   ◇ (1)   △ (2)   ■ (3)   ◆ (4)   ✕ (5)   ▲ (6)

Graph 611

A/L Ratios for 30:10 Term Assurances

Graph 612

A/L Ratios for 30:25 Term Assurances

Graph 613

A/L Ratios for 40:10 Term Assurances

Graph 614

A/L Ratios for 40:25 Term Assurances

Graph 615

A/L Ratios for 50:10 Term Assurances

Graph 616

A/L Ratios for 50:25 Term Assurances

Graph 701

A/L ratios for the combined office:
AIDS in the experience only from 1984;
No changes to term assurance premium rates .

Graph 702

A/L ratios for the combined office:
AIDS in the experience only from 1984.
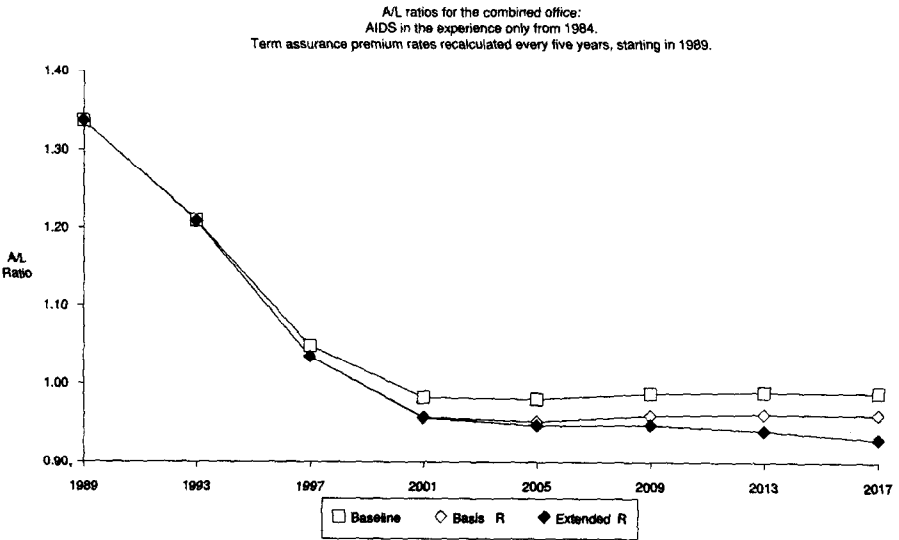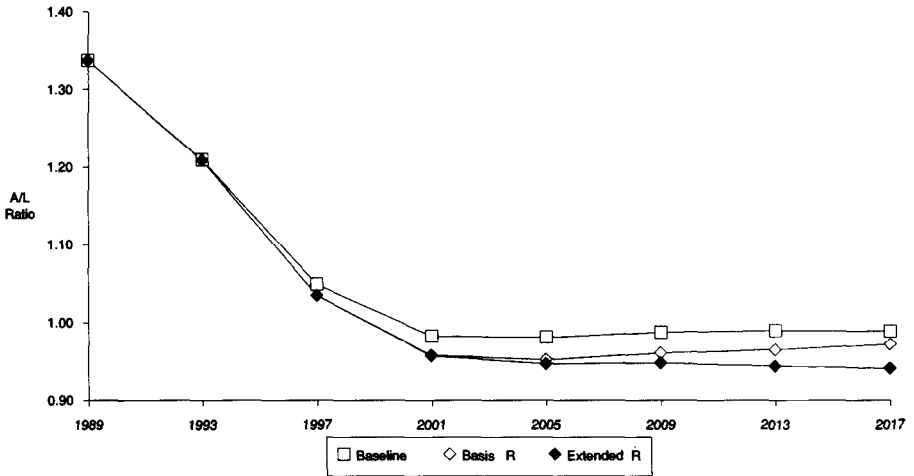Term assurance premium rates recalculated every five years, starting in 1989.
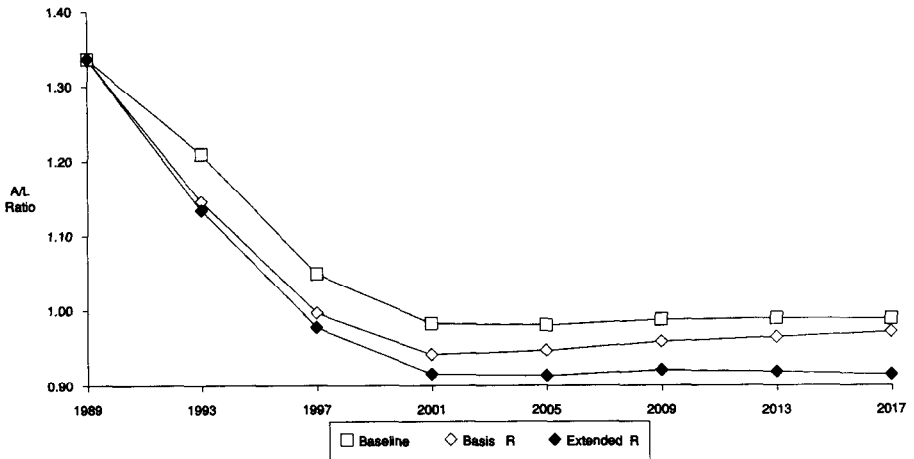
Graph 703

A/L ratios for the combined office:
AIDS death claims are deducted from Asset Shares
Term assurance premium rates recalculated every five years, starting in 1989.
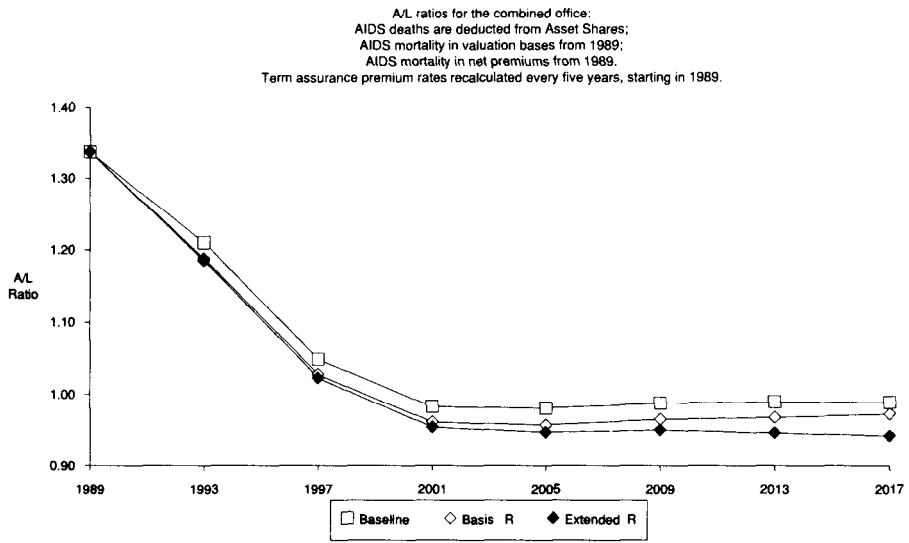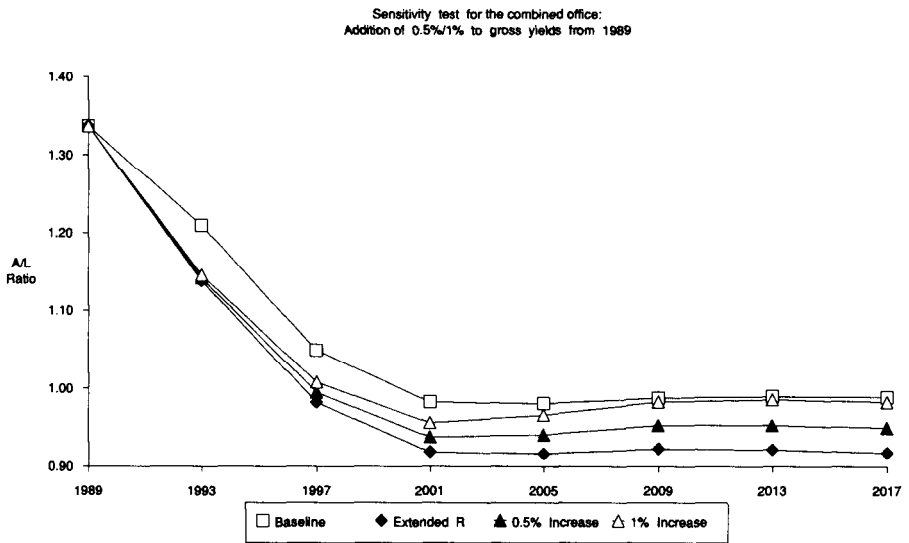

Graph 704

A/L ratios for the combined office:
AIDS death claims are deducted from Asset Shares;
AIDS mortality in valuation bases from 1989.
Term assurance premium rates recalculated every five years, starting in 1989.

Graph 705

A/L ratios for the combined office:
AIDS deaths are deducted from Asset Shares;
AIDS mortality in valuation bases from 1989;
AIDS mortality in net premiums from 1989.
Term assurance premium rates recalculated every five years, starting in 1989.

Graph 706

Sensitivity test for the combined office:
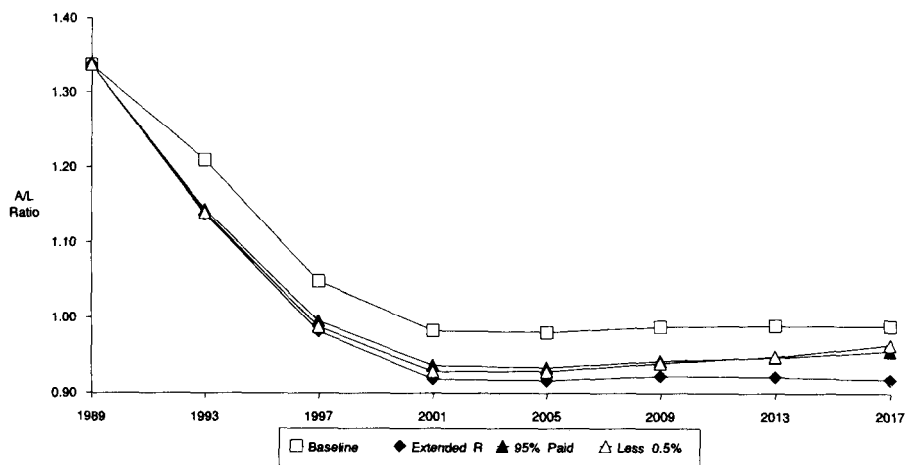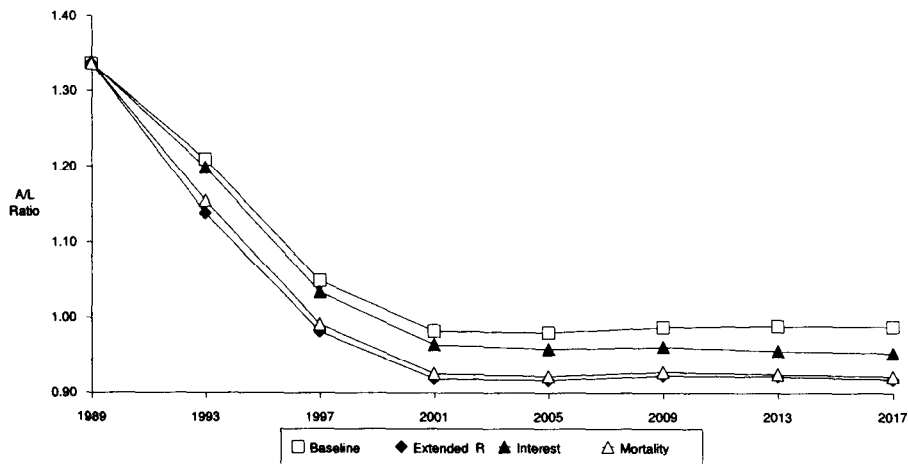Addition of 0.5%/1% to gross yields from 1989

Graph 707

Sensitivity tests for the combined office:
(i) Maturities and Claims based on 95% of Asset Shares from 1989;
(ii) Net rate of interest accruing to Asset Shares is reduced by 0.5% from 1989.

Graph 708

Sensitivity tests for the combined office:
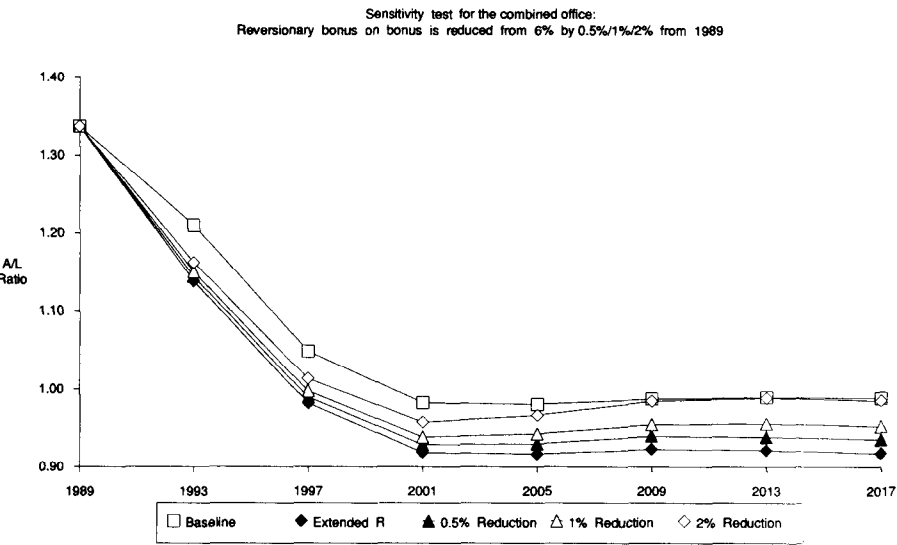(i) Valuation interest rates are increased by 1% from 1989;
(ii) Valuation non-AIDS mortality from 1989 is the CMI 1979-82 experience.

Graph 709

Sensitivity test for the combined office:
Reversionary bonus on Sums Assured is reduced from 3% by 0.25%/0.5% from 1989

Graph 710

Sensitivity test for the combined office:
Reversionary bonus on bonus is reduced from 6% by 0.5%/1%/2% from 1989

Graph 711

Sensitivity test for the combined office:
Expansion rate is reduced by 4%/8% from 1989

Graph 712

Sensitivity test for the combined office:
Premium rates for Low-Cost Endowments are not altered in 1984
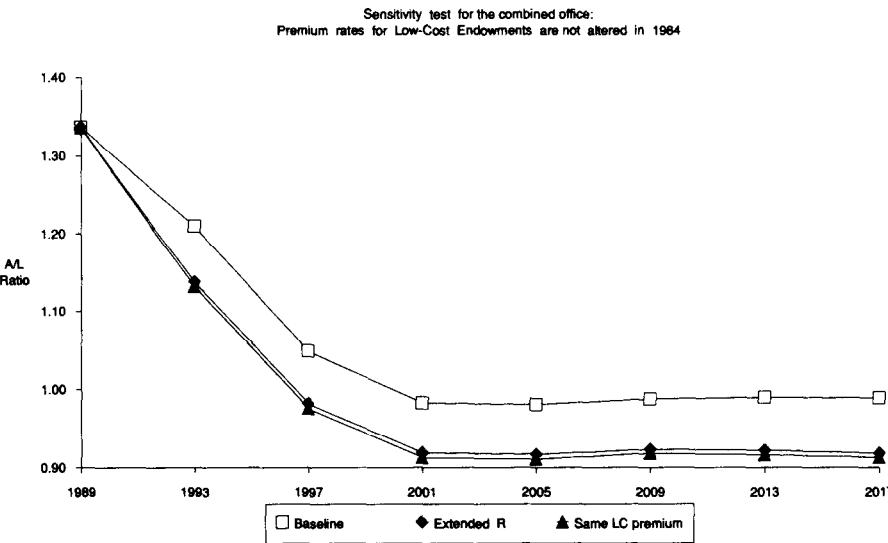
DISCUSSION

Dr M. Ljeskovac, introducing the paper, said:—On behalf of the Mortality Research Group, I would like to say that we feel honoured to have our paper discussed here tonight. We also look forward to the discussion, and my introductory remarks will be accordingly brief.

Firstly, we wish to thank the Institute of Actuaries AIDS Working Party for providing us with copies of their material and for allowing us to be present as observers at their meetings.

The topic of AIDS needs today no introduction. When the current Mortality Group was formed about two years ago, it was clear that AIDS was the obvious topic to be investigated under the mortality heading.

We had the good fortune that one of our members had already developed a computer model of a life office. We used this model as a tool for the paper. In the course of the work, the model was further developed at the same time. The main features of the model are probably its portability, comprehensiveness and user-friendliness. As an experiment, in addition to the paper itself, we are also presenting a copy of the programme with the accompanying documentation to those who may be interested. Inevitably, we have had to leave various topics and parameter variations out of the paper, but if anyone wishes to try out something we did not, then he could use the programme.

Secondly, I should like to deal with the paper itself. Given the work of the Institute Working Party, we saw no point in attempting to produce a different, or extended version of David Wilkie's underlying model. Rather, our intention has been, as we say in paragraph 2.1, to explore the implications of AIDS tables that were produced by the Institute Working Party. The choice of the additional mortality tables has not been easy. We will describe the reasoning that led us to adopt what we call the Extended R mortality basis, in addition to bases F and R, in Section 2. Other assumptions that were needed to develop a mature model office are given in Section 3 and Appendices 1 and 2.

We set the foundation of our model office in 1949, starting with ordinary endowment contracts and then projected it forward under conditions similar to those prevailing in the years since 1949. In general, the years of introduction of AIDS into the model, where applicable, have been 1984 for the experience and 1989 for the valuations, with 1984 as the base year. The projections generally go forward as far as the year 2021.

Our approach to examining the impact of AIDS is given in Section 4. In order to investigate the interaction between different classes of business, we first considered ordinary endowments, low cost endowments and term assurances separately, and then combined them to produce a more realistic model. Our investigations and results are set out in Section 5 for ordinary and low cost endowments, Section 6 for term assurances and Section 7 for the combined funds.

In general, the effect of AIDS was measured by examining the ratios of funds' assets to the published liabilities (in the sense of Schedule 4 valuation regulations plus the statutory solvency margins). The investigations have been twofold: we first looked at the direct consequences for the asset/liability ratios of introducing AIDS, and then at the magnitude of changes in other factors that would best compensate for the effect of AIDS. We stress that we are not trying to suggest that a particular course of action would be advisable for a real office to follow; rather, we were interested in the relative magnitude of the changes under various assumptions.

For the first part, measuring the direct impact on asset/liability ratios, we have assumed a no changes in with-profit premium rates. We examined the ratios on different circumstances, for example with AIDS only in the experience but not in the valuations or in the premiums, and then in valuation bases as well, and then with valuation net premiums recalculated or not recalculated, and also with term assurance premium rates recalculated to allow for AIDS just once, or every five years, or not at all. We also investigated what would happen if AIDS-related death claims were ignored from the calculation of asset shares so that maturity values would not be affected.

For sensitivity tests, we list the results in tabular form at the end of Sections 5 and 7. The range of the tests is by no means exhaustive, but the results are probably sufficient to get the feel for the relative effects. Examples of such tests are reductions in declared bonus rates, increases in the rate of return on the assets, and charges levied on maturity proceeds.

The graphs we have produced display values at 4-year intervals: 1981, 1985 and so on. There is nothing special about the years we have chosen: we had to balance the amount of output produced by the programme and the level of detail, and these 4-year intervals seemed about right.

We have not included the investigation of other types of contract, such as pension and unit-linked business. Time was short, and the Paper already seemed long enough. Although the programme can calculate mismatching reserves, all the projections have been made excluding such calculations. Finally, we have not examined the effects of lapses, selective or otherwise.

In summary, we feel that the danger of AIDS as regards life offices should not be underestimated. We have attempted to show potential effects on the basis of extensive assumptions, explicit and implicit. We hope that the computer programme we have been using will be of wider benefit to the profession and that both the paper and the programme will be useful for future studies. Thank you.

Professor A. D. Wilkie, opening the discussion, said:—Although I am opening the discussion on the paper before us this evening, I think it would be helpful if I were to start by surveying the latest statistics about AIDS around the world, and I intend to spend a bit of time on doing that.

In 1982 there were three cases of AIDS reported in the United Kingdom. In succesive years, that is from 1983 to 1989, the numbers of new cases reported were 26, 77, 160, 305, 653, 758 nd 848. The total by the end of 1989 was 2,827.

If we consider the first five of these years, we see that the number of cases between 1983 and 1984 multiplied by three and then between 1984 and 1985 multiplied by two; the next year they almost doubled again and the next year more than doubled. In the last two years, however, the percentage increases have been much smaller, only 16% and 12% respectively.

At the end of 1987 it seemed reasonable to suppose that we were still in a period of exponential increase in the number of cases. In any epidemic exponential increase cannot carry on forever, and the early calculations of the Institute of Actuaries AIDS Working Party and of other epidemiologists showed how the AIDS epidemic might be expected to have an initial exponential phase followed by what might appear to be a linear phase, then a levelling off to a summit, followed by a downturn. In the United States the exponential rate of growth had been going on for some years longer than in the U.K. and showed little signs of slowing down. It was reasonable to assume that the UK might be following a year or two behind the United States. As it happens the change to linearity seems to have happened in the United States and the United Kingdom at the same time. I have figures for the United States comparing the year from February 1988 to January 1989 with the year from February 1989 to January 1990. The number of new cases reported in the second of those years was 12% up on the previous year. This is a similar percentage to that seen in the UK.

The World Health Organisation also publishes figures. Unfortunately there are problems about the precise dating of these; this is a problem with all AIDS reporting where there are reporting delays which are not always entirely made clear by those who receive the reports. When the WHO publishes figures as at 31st January 1990, it means cases that have been reported by the national reporting authorities to WHO by 31st January 1990; there are considerable delays in the reporting by different countries, some of them reporting figures as at December 1989 therefore reporting quite quickly, but others who haven't reported since 1987, which gives a rather curious result. However, taking the figures as they stand we can calculate the percentage increase during 1990 in the cumulative number of cases (that is slightly different from the figure I was quoting before). That is the number of cases in 1989 as a percentage of the cumulative total up to the end of 1988. There was a 40% increase in the United Kingdom and a 39% increase in the United States. However the number of cases in the United States is now nearly 118,000—it is not a trivial problem, it is an enormous epidemic there.

Percentage increases of around 40% have been observed in some other countries such as France at 42%, Australia 37%, Canada 50%, West Germany 55%. But many other countries show continuing much more rapid increases. The cases reported from Brazil doubled in 1989 to over 9,000, from Kenya more than doubled to over 6,000, in Italy showed a 76% increase, in Spain an 83% increase, and in Mexico an increase of 109%. I have omitted some of the exceptional countries like Malawi and Congo where the numbers apparently did not increase at all, but that

is just because they have not reported any figures for a couple of years. There are other exceptions, like Zaire, where the number increased apparently from 300 at the end of 1988 to over 4,600 at the end of 1989, again reflecting reporting delays.

When the countries on the WHO list are sorted according to the total numbers of AIDS cases so far, the United Kingdom was 12th on the list at the end of 1988 and 13th at the end of 1989. The countries ahead of it in 1989 in sequence are the United States, with nearly 118,000 cases; Brazil with 9,500 cases then France, Uganda, Kenya, Tanzania, Italy, Zaire, West Germany, Spain, Mexico and Canada. Just below the U.K. on the list come Malawi, Zambia, Burundi, Haiti, Rwanda, Australia, Congo, Switzerland, Zimbabwe, Dominican Republic, Ghana, the Netherlands and the Ivory Coast. Those are all the countries with more than 1,000 cases recorded, and you can tell quite a lot about the geography of AIDS by where those countries are; very many of them are in East and Central Africa.

Another way of putting the countries in sequence is by the number of AIDS cases per 100,000 population. In this ranking the United Kingdom comes 56th out of about 150 countries listed. The United States is 7th with 47.6 cases per 100,000 compared with the United Kingdom's 4.9 cases per 100,000. Above the United States comes Bermuda with 226 cases per 100,000—that is therefore 50 times the density level in the U.K. Also higher are French Guiana, Bahamas, Turks and Caicos Islands, Congo and Guadeloupe. Out of the first 30 countries in the list ranked this way, 16 are in the Caribbean, 10 in Central and East Africa and the other 4 are in the United States, Switzerland which is second among developed countries with 18 per 100,000, France with 14.5 and Canada with 12.4 so AIDS is a great deal more serious in some other countries than it is here.

Another international comparison can be obtained from figures published by the WHO Collaborating Centre on AIDS in Europe. This gives more detailed figures for different European countries. The latest I have are for 30th September 1989 and I want to look at the distribution by transmission group.

In many countries homosexuals and bisexuals provide the largest single transmission group. In the United Kingdom over 80% of cases fell into this category and the same high percentage is found in the Netherlands and also in Iceland, Poland and Czechoslovakia, all of which have quite a small number of cases. Only 72 cases in the U.K., that is 3% of the total, were attributable to intravenous drug users. This compares with 66% of cases—over 3,000 of them in Italy—and 63% of cases in Spain attributable to drug use. In France there are over 1,300 cases attributable to the same cause, that is 17% of the cases there. In Switzerland there are 330 cases, which is 32% of the cases there and in Germany 470 cases, that is 12% attributed to drug use. Even in Ireland 34% of cases are attributed to drug use, though this is only 37 cases out of roughly 100.

I suppose it is possible that in certain countries some of the explanation for these figures may be that it is more acceptable for someone to claim that they are a drug user than that they are homosexual. The legal penalties may be less severe for one than the other. I think we should take them somewhat at face value and recognise that drug misuse is a big problem in many countries, particularly in Southern Europe.

Amongst other transmission groups the picture in other countries is also different from that in the U.K. The proportion of haemophiliacs affected is not very different in different countries, but in France there have been 559 transfusion recipients compared with only 44 in the U.K. who have developed AIDS, not just become HIV positive. In France there have been 817 cases of reputed heterosexual transmission, compared with 123 in the U.K. and in France there have been 170 reported cases of mother-to-child transmission compared with only 22 in the U.K. Again, these are cases of AIDS. There have been many more cases reported of HIV transmission from mother-to-child, but the figures above relate to the children who have then developed AIDS. This compares with 1,675 cases of children in the United States who have been infected from their mother.

Another way of looking at the cases is by sex. In the U.K. there had been 114 females infected by the end of December 1989 compared with over 1,000 in France by the middle of 1989 and about 12,000 in the United States by the end of 1989. The Institute AIDS Working Party made a distinction between primary risk groups, that is heterosexuals, drug users, haemophiliacs and transfusion recipients; secondary risk groups, that is the sexual partners of those in the primary risk groups, and tertiary infection, that is heterosexual infection from somebody who is not in a

primary risk group. In the U.K. exactly 50 out of the 114 females with AIDS have been infected by heterosexual contact. Of these 15 were secondary infections and 31 have been infected either abroad or by partners who have been abroad, leaving only four cases of tertiary infection. Among males there have only been nine cases of tertiary heterosexual infection.

It is clear that the spread of AIDS into the heterosexual population in the U.K. (which may well be occurring) has not yet resulted in any significant number of cases. This is in complete contrast with the position in Africa, where a very large number of cases are thought to arise through heterosexual contact.

This all has relevance when we consider the Institute of Actuaries AIDS Working Party's Projection R. This is admittedly only a model for homosexual spread, although it was calibrated against the total number of cases that had occurred in the U.K. The projected number of cases are shown in Appendix 4 of AIDS Bulletin No. 4 and they must match up with the facts very well for 1984 to 1987 since they were calibrated to do so. The forecast numbers of new cases for 1988 and 1989 were 1,052 and 1,798 respectively. The actual number of cases reported in the U.K. have been 758 and 848 respectively. It is now clear that even Projection R is fairly heavy but I do not think that we should be complacent. The heterosexual time bomb may still be ticking away and erupt by the end of the century.

The explanation for the lower number of cases coming through than was expected is, I suppose, because the homosexual community in Britain, particularly in London, realised what was happening about AIDS in the very early 1980s, well before AIDS had achieved any publicity in the general population, and they changed their sexual behaviour accordingly. There is supporting evidence for this from the statistics of other sexually transmitted diseases, which showed a considerable decline among homosexuals in the early 1980s. I suppose if we had been more aware of these figures at the time that the Working Party's projections were made we might have taken more account of them.

The other figures worth looking at are the number of recorded cases of HIV infection. After a lot of initial testing in 1985 the number of new HIV infections reported in England and Wales in successive years have been 2,338 (1986), 2,212, 1,680 and then 1,780 in the years 1986 to 1989. The downwards trend was reversed slightly last year, but it is too soon to say that there is any upwards trend in these numbers.

Whether these reports accurately reflect the real number of new infections is a different matter. It has often been suggested that many people are inhibited from going to be tested, and are even discouraged from doing so by their medical advisers, because of the adverse impact if they might wish to take out an insurance policy. If this argument carries any weight it shows how difficult the position of insurance is in such a situation. To us, associated with the industry, it seems obviously unreasonable that those who are HIV positive should obtain life insurance at normal rates and impracticable to offer them life insurance at realistic rates in view of the presumption that their expectation of life is so much reduced. Yet it does seem fairly sensible from the point of view of the applicant, who may really not know whether he is positive or not, though he may have an idea that he has taken a risk of becoming positive, that it is not unreasonable for him to effect insurance in genuine ignorance rather than take the trouble to be tested and thereby possibly exclude himself from obtaining a policy. The consequences for the statistics are one thing, the conseqences for himself may be more serious if in fact it were possible that some prophylactic drug might be available which would delay the onset of the disease if in fact he were to prove positive. I do not know the answer to this sort of problem but it is a matter partly of ethics and partly of public policy which insurers should recognise exists.

The authors of the paper do make reference in Section 2 to the proportions identified as HIV positive and they compare them with the actual AIDS cases. In paragraph 2.2 they draw attention to the different distributions of HIV positives and of AIDS cases by transmission groups within the U.K. and in paragraph 2.4 they refer to the same items, but for England and Wales, this time sub-divided by Health Region, and they draw attention to the different distributions in each case. I think in both cases there are some special factors that need to be taken into account.

Because blood is taken from haemophiliacs for a variety of other purposes and stored in frozen samples, it has been possible in most cases to test the HIV positive status of haemophiliacs. They form a rather higher proportion of the HIV positives than of the AIDS cases and it might be

reasonable to assume that they are spread across the country in proportion to the population; at least they are certainly not all concentrated in the North West Thames Health Region.

Drug users are another special case. Edinburgh has achieved considerable publicity because of the large number of HIV positive drug users discovered there. The actual number of cases has so far been very small. However it is possible that this is at least partly because of local circumstances, in that there is a particular community of drug users that I understand reside mainly in a closely defined area and that mostly belong to one or two medical practices. The doctors in these medical practices are interested in research. So the Edinburgh drug users have been well researched whereas drug users in England may not be nearly so concentrated in particular practices which would make research into their numbers easy. This means that looking at the HIV positives in the U.K. there is a high proportion of drug users identified but only a small proportion of them have developed AIDS so far.

In spite of these anomalies the authors are right to point out that the different characteristics of the epidemic in the risk groups other than homosexuals mean that the Working Party's model and method of calibration has limited validity. It would be nice to develop a model which takes into account all the different risk categories and the transmissions between them. Work on this has been done in Germany and in the United States, but it is easy to see that the number of parameters or parameter functions required in such a model grows enormously and there is almost no information on which to base estimates of these parameters and hardly enough cases in the U.K. to calibrate them.

The experts who produced the Cox Report on HIV infection in England and Wales and those in nearly the same group chaired by Professor Nicholas Day, who produced the recent PHLS report, found the same difficulty. The Day Report does make forecasts for numbers of possible new AIDS diagnoses among drug users and heterosexual contact cases over the years up to 1993. This is not nearly far enough for insurance purposes, but even so the range is pretty wide. A lower projection and an upper projection are given as well as a preferred estimate which is somewhere in between. For drug users the projected number of new AIDS diagnoses in 1993 ranges from 50 at the lower end to 1,000 at the upper end with a preferred estimate of 400. For heterosexual contacts the range is even wider, from 50 to 1,500 with a preferred estimate of 650. I think all this means is that the members of the Working Group (myself included) do not know what the number of cases in these groups will be. I do know that no integrated epidemiological transmission model was used to produce these numbers.

This Research Group points to the wide difference in density of AIDS cases on a geographical basis with an enormous concentration in the Thames Health Regions. It is reasonable to assume that the epidemic will spread out from its initial main concentration and the Research Group is right to point out that the density of HIV positive reports is higher in the provinces of England than is the number of AIDS cases. This could indeed mean that the epidemic is still to emerge in the areas outside London, but it could also mean the epidemic would be very much smaller outside London. We know too little about the sexual behaviour of homosexuals in different parts of the country and too little about how that behaviour may have changed in the light of the AIDS epidemic.

To summarise so far. When the Institute Working Party first produced its Projection F in late 1987, it seemed to be a possible projection on the lowish side. A year ago it seemed to be about the middle of the range. It now seems to be rather conservative. Projection R is just Projection F reworked to give a better age calibration. In another one or two years it may be possible to see the extent to which Projection R is proving unnecessarily conservative, but in the meantime I strongly agree with the Research Group that it would be unwise to use any more optimistic basis for the time being.

Now having spent a lot of time on the background I don't want to spend very much time on the details of the paper itself.

Having myself done in the past the sort of sensitivity analysis that the authors have done, I realise that it is difficult to present it in a way that makes exciting reading however interesting it is to do. Nevertheless I think it is important that it has been done and valuable it is put on record. Even without the AIDS calculations which were the point of the paper, the Research Group has done two other very useful tasks. They have developed a model office on the basis of a moderately

realistic actual experience since 1949 and they have shown the sensitivity of such a model office to a whole range of changes and conditions. Admittedly the changes are measured mainly after adjusting the original baseline to the Extended R AIDS basis. The general effect of what the changes would be against the baseline can readily be seen. There is no reason to suppose any particularly significant interaction between the mortality basis and any of the main factors that the Research Group has considered.

I have a few small points to make.

I think it would help to note that the graphs 611 to 616 referred to in paragraph 6.3.2 are all based on assumption (6). Assumption (6) and paragraph 6.3.1 which the misprint shows should be actually up in basis 4 but with AIDS mortality included in the valuation net premiums. At least I think that is true.

In paragraph 6.3.1 the authors refer to the extent to which offices may have to pay attention to the developing experience of AIDS and pursue an active premium rating policy in future. This emphasises the necessity for continued monitoring of the AIDS position and the mortality experience of each office.

The authors have chosen to concentrate on the asset to liability ratio. This seems a reasonably sensible measure for endowment insurances but the rather higgledy piggledy results shown in graphs 607 to 610 makes me wonder whether a different measure might not have been worth exploring. An alternative would have been the difference; assets minus liabilities, and the change each year in this figure, i.e. the emerging surplus or strain, possibly measured in relation to the total sum assured or total premium income to eliminate the effects of changing portfolio size.

I have to confess that I did not learn much from Section 7 that was not already apparent from Sections 5 and 6. The model office is so dominated by low cost endowments as the years go by that the results for the combined office are rather little different from those for low cost endowments. However, it was perhaps comforting to demonstrate that the effect of term assurances on the total portfolio was not excessive.

A great deal of work has gone into this paper and the authors deserve every credit for having produced it. Not only does it put the AIDS problem into a proper perspective in relation to the operations of the office as a whole, but it has provided the tool for others to work with for many other quite unrelated purposes. I welcome the paper and I look forward to the rest of the discussion.

Mr D. Pike said:—I would like to thank the Working Party for tonight's paper and especially Angus Macdonald for this model office programme which he has so generously made available to other actuaries.

Professor Wilkie has already discussed the pattern of AIDS cases so I will not dwell on this first table at all. It shows AIDS deaths whereas Professor Wilkie was talking about AIDS cases. What concerns me, if attention is paid to AIDS deaths, is that the problem table seems to start before the levelling out in the last two years and that the projections appear to overstate the actual number of deaths up to 1987; perhaps that is the way in which it has been calibrated. I appreciate the actual numbers may be distorted by reporting lags and as the Research Group point out in paragraph 2.6, by significant under-reporting. I do not think these figures change the fact that the actual numbers appear to be increasing less steeply than projections, unless there has been a great change in the pattern of reporting. It is quite possible that under-reporting may have increased because there has been a certain amount of publicity in recent years which may have left many doctors with a vague impression that insurance companies are somehow hostile to AIDS victims. Those doctors may tend to omit to mention AIDS in the death certificate.

I agree with the statements in paragraph 2.2 but it may be better to calibrate future projections against the homosexual/bisexual group alone. However, there is a suggestion that homosexual spread is no longer so predominant. This suggestion was reinforced recently by the Director of the British Medical Association Foundation for AIDS, who said that by 1993 most AIDS cases in England and Wales could be among heterosexuals and drug users. I am not yet convinced that this will necessarily affect insurance companies because other than the much greater proportion in the undetermined category in the HIV positive figures in Table 2.2, the main difference is in the

higher proportion of drug abusers and haemophiliacs.

My next table shows the number of AIDS cases by risk group, taking advantage of more recent figures than were available to the Research Group at the time. In the last column I have excluded drug abusers and haemophiliacs on the assumption that offices will always recognise these groups as high risk for underwriting purposes and will have tried to identify them. I have also excluded children, who are surely the most tragic victims of this disease, on the assumption that their infection is usually identified quickly and they will not be represented in the insured population to any great extent. Of the remaining groups, homosexual/bisexual represents over 90% of the cases.

My next table shows the same analysis of reported HIV positive persons and again I have excluded the same risk groups in the last column as before.

If we now make the assumption stated in Section 2.2 that most of the 23.9%, other undetermined, are homosexual or bisexual then this group still represents about 90% of cases.

In Section 2.4 the Research Group point out that a disproportionate number of AIDS cases (currently 72%) have been reported in the four Thames regions and put forward the possible explanation that AIDS victims may tend to seek treatment in London. I think there are good reasons why this may be the case. Firstly, there are the good medical facilities available in London, and for that matter, in Edinburgh, which is the other centre mentioned by the Research Group as having a high concentration of AIDS cases, and secondly there is the patient's wish for confidentiality which perhaps can be better served if they moved to London.

One area in which I would like to have seen more discussion in the paper is that of equity between generations. The effect of setting up deficiency reserves may significantly distort the emergence of surplus, depending on the particular office's proportion of protection business, etc. This may adversely affect the maturity proceeds of policies maturing in the next few years, even though the additional reserves are in respect of AIDS claims during the next thirty years or so. Use of an asset share approach to determine terminal bonus rates should enable the actuary to avoid inequity, but there may be cases where the asset share approach is constrained by the published valuation and the actuary may be either unwilling or unable to weaken his published valuation basis in other ways. In these circumstances, I consider it could be an acceptable course of action to set up AIDS reserves with net premiums recalculated to include AIDS mortality, provided that the recalculated net premiums are limited to the office premiums less an allowance for expenses, and notwithstanding the erosion of the margin for future bonuses. I wonder if the Research Group could confirm on this point that the limitation on expenses has been applied in Section 5.3.

The actuary of a proprietary non-profit fund of which the shareholders receive 100% of the profits does not have to worry about equity between policyholders, but he may still have to investigate the extent to which the setting up of deficiency reserves distorts the flow of profits to shareholders.

Finally, the paper is written almost entirely from the perspective of the office and it is perhaps a little disappointing that the opportunity was not taken to investigate the effects on policyholders' maturity proceeds. I feel this is especially relevant to low cost endowments sold before the risk of AIDS was generally recognised and in a period of historically high investment returns. I would have welcomed the investigation of the circumstances in which the effect of AIDS in combination with a reduction in investment returns could lead to levels of maturity proceeds below the levels required to pay policyholders' mortgages in full.

Mr D. O. Forfar said:—I, too, would like to express my congratulations to the Mortality Research Group for the interesting research work they have carried out. Speaking as Chairman of the Research Committee it is a particular pleasure for me to see a Research Group's work culminating in a Faculty Paper.

I think it is not surprising that the Mortality Research Group should have looked at the effect of AIDS which is the most important influence on assured lives mortality at the current time, and they have looked at how an office is affected by the likely increase in mortality to a level given by the Projection R basis. However, up to now, I feel that attention has tended to focus on underwriting aspects and term assurance business. What is new in tonight's paper is a study of the

effect of a with-profits fund and the consequences for certain financial ratios. As the paper shows, and despite the criticisms that have been levelled at the with-profits policy in recent years, the with-profits policy has flexibility to cope with significant changes in mortality experience by, for example, adjustments to terminal bonus rates. These rates have the virtue of being calculated at the end of the term when a retrospective look at past mortality can be made. This does seem indeed an occasion where adjustments can be made with the benefit of hindsight. Furthermore, the authors have shown that certain counter-measures can be taken if desired to prevent a deterioration in financial ratios such as the assets/liability ratio, for example by increasing the valuation rate of interest or changing rates of reversionary bonus. A point which emerges to my mind is the flexibility of the with-profits product, and in comparison unit-link business is in more of a straightjacket, or at least any adjustments have to be made more explicitly, for example by declaring explicitly the revised basis on which mortality charges will be made.

The model office approach has enabled the effect of the increased mortality to be quantified, both for ordinary endowments and low cost endowments and it is interesting to note in paragraph 5.3.3 that the increase in reserves, allowing for AIDS in the valuation factors on the R basis, is 4.6% for low cost endowments and 0.18% for ordinary endowments. Indeed if the AIDS factors are incorporated into the net premiums, the effect is to hardly increase reserves at all. It is certainly useful, I feel, to have an indication of the sort of increase in reserves implied by valuing on the Extended R basis. Indeed the generally accepted thesis that ordinary endowments are fairly insensitive to mortality seems borne out, and even for low cost endowments the overall effect of AIDS on the financial ratio seems relatively small compared with the effects which other changes can induce. As the paper shows, assets/liability ratios are affected by, for example, changes in reversionary bonus rates, rates of expansion, etc. and graphs 709 and 710, show that changes of a half percent in the rate of bonus in sum assured, or 2% on the rate of bonus on bonus, or 8% on the rate of expansion, induce changes to assets/liabilities which are just as significant as those for AIDS. It seems quite possible indeed that the effect of AIDS on financial ratios, in respect of the with-profit business, could be swamped by other changes which were affecting an office, for example, if there was a significant change in the rate of expansion or changes which the office was making anyway, for example, if reversionary bonus rates were being reduced because of a desire to seek a better balance between reversionary and terminal bonuses. Likewise I feel it is interesting to see those changes which have little effect on the financial ratios. For example, switching to a new standard mortality table based on the experience of the years 1979-1982 as opposed to the standard table A 1967-70 has little effect.

The authors state their conclusions in Section 7.8 with a table on putting the effect of AIDS into context alongside other changes in the experience of the office. I think I would like to have seen more of the conclusion deduced from this table. I think the conclusion the authors are pointing towards is that the with-profits fund has adequate flexibility to cope with AIDS without too much difficulty and without upsetting financial ratios too much, but I would like to hear if that is also the authors' general conclusion.

With regard to term assurance business, there is not such great flexibility as with with-profits and I do not find the graphs of assets/liabilities so meaningful. Indeed I doubt if assets/liabilities ratios are the aspects to concentrate on for term assurances. In paragraph 6.4 the authors describe the failure of the counter-measures which worked for with-profits business. The only remedy for term assurance is the regular recalculation of premium rates, although here there can be a lapse and re-entry problem if Projection R is used rather than R Extended, which is a point I do not think the authors make.

I note the Research Group has used a model office and as a user of model offices myself, I have certainly no criticism of that. On the contrary, I feel model offices can be a very useful tool and are going to be increasingly used in the future. Thanks to the Research Group a model office is now generally available to everyone, so to speak, off the shelf, and I welcome this development. So I thank the Research Group both for tonight's paper and for making a model office more generally available.

Mr C. D. Daykin, F.I.A said:—I very much welcome the work that has been carried out by the Faculty Mortality Research Group and congratulate them on their lucid presentation.

It builds on the work that has been carried out by the Institute AIDS Working Party, where we have acknowledged that we have not been able to devote enough time or resources to developing a model office, and the Research Group's model office is a powerful tool in its own right which I welcome, and I am pleased to hear that it is going to be made generally available.

The extensive investigations described and graphed in the paper serve to demonstrate that the spread of the HIV infection at the level implied by Projection F, R or Extended R will not have too significant an effect on ordinary with-profits endowment business as the previous speaker mentioned. Far greater uncertainties are ahead on the investment side. Indeed the baseline projections themselves, which are shown in the paper, show a dramatic fall in the assets/liability ratio over the next few years, quite apart from the impact of AIDS arising out of the other assumptions that are made in the model.

Low cost endowment business on the other hand is likely to be more susceptible to the impact of AIDS and here there are more significant potential problems on the horizon because of the nature of the business. We see from the summary of the sensitivity analysis in paragraph 5.5 that a reduction of half percent a year in the reversionary bonus on sums assured, 2% a year on bonus on bonus, or 8% of asset share on the maturity benefit would be equivalent to the effect of AIDS at the level of the Extended R projection and it is possible that, as Mr Pike mentioned earlier, those adjustments to the bonus figures could be significant in relation to the policyholders returns, but on the other hand there are other uncertainties which again, as with ordinary with-profits endowments, may be more significant.

Term assurance business is the most susceptible and it is notable perhaps that the paper is written from the perspective of an office where term assurance is not a major part of the portfolio; other insurance companies with a different portfolio structure may find this of more concern to them. The changes of course in reserves are small in absolute terms because of the small size of the reserves to start with, but the premium rates are very sensitive to AIDS and there are other issues which are to some extent glossed over in this paper such as underwriting standards, anti-selection, the class of business being written, and the marketing problems of this type of business which are important and are likely to cause significant problems for companies whose major business is in this field.

I am not sure that I recognise the recommendation that was ascribed to the AIDS Working Party that people should use Projection BC for premium rating, as was suggested in paragraph 6.1 of the Research Group's paper. We certainly refer to Projection BC as a suitable projection for considering in our AIDS Bulletin No. 2, but the choice of bases depended very much on what the office was likely to do in relation to underwriting, and that was an aspect which we emphasised. As we were preparing AIDS Bulletin No. 2, we took the view that the possibility of reducing the effect of AIDS by effective underwriting was relatively limited unless very extensive antibody testing was carried out at a much lower level than it was then, or is now the case, and unless also those who are in the at risk category can be identified as well as those who are HIV positive or have AIDS. As the epidemic continues that may become less of a factor and the importance of testing as a major way of establishing the people at risk will be of greater and greater importance.

As Professor Wilkie and other speakers have already indicated, the prognosis certainly seems less pessimistic now than it did when we produced AIDS Bulletin No. 2. Indeed it is a year since we produced AIDS Bulletin No. 4 and even the projection shown there now seems to be on the high side in the light of more recent reports of AIDS cases. One of the problems, however, is what you should calibrate against and Mr Pike has already alluded to there being a significant problem known to exist in relation to under-reporting of AIDS deaths. Various work done by, for example, Anna McKormick of the Office of Population Censuses & Surveys, and also Desmond Le Grys in this area suggested that the deaths actually reported to be from AIDS may be of the order of 50% of the actual deaths.

For understanding the prognosis of the epidemic it is also better to look at diagnoses of AIDS cases rather than reports. Unfortunately, we do not know what the diagnoses are until some time after the event because of long reporting lags. The procedure in the PHLS Working Group was first to try and estimate the diagnoses of the cases of AIDS and then to use that as a basis for projection. However, that report was concerned only with the period up to 1993 which is rather short for our purposes. They did, however, look at the pattern of HIV infection and that is quite

illuminating because the strong conclusion which arose was that new infections amongst homosexuals had almost certainly peaked in around 1984 and had then fallen quite sharply. A more recent resurgence of growth cannot be ruled out but the pattern tends to imply that perhaps only 10 to 15,000 homosexuals are currently infected in the U.K., which is at the bottom end of previous ranges of estimates.

The focus of attention switched to injecting drug users and heterosexuals and in each of these categories the numbers of cases of AIDS diagnosed so far, albeit relatively small, is consistent with both the late start to the epidemic and potentially exponential growth currently. If you take the fairly pessimistic assumption of continuing exponential growth, which as Professor Wilkie has mentioned on general grounds is unlikely to continue for very long, one could arrive at a figure for cases of AIDS in 1993 (as the Working Group did) where the numbers were more or less equally divided among homosexuals, heterosexuals and injecting drug users. One would deduce from that that the numbers infected with HIV at the moment could be up to 35,000 or so roughly equally split between those three groups.

Now only time will tell whether this scenario is realistic. We have already got an anonymous testing programme which was started at the beginning of this year that should provide some information about the prevalance of HIV infection. There is a survey of the sexual behaviour of individuals which is going ahead on the basis of private funding as it was not funded by the Government and that will give some indication of the groups most at risk and the possibility for future spread.

For the time being the future remains very uncertain and the longer the term the greater the uncertainty. Projection R looks rather prudent now in relation to the homosexual epidemic as it is emerging at the present moment, but it is clear that insurance companies need to take account of the more extended epidemic resulting from heterosexual spread, although the appropriate level to be considered can at the moment only be guessed at. The Institute AIDS Working Party suggested levelling off Projection R at the peak level of mortality rates and the Faculty Mortality Research Group called this Extended R and adopted it for their work. It is only a very rough and ready way of making some allowance for heterosexual spread and it is likely to be some time before it is possible to do anything much more sophisticated. If female business is significant then of course there also needs to be some allowance made for AIDS mortality amongst females.

Speaking now with my Government Actuary's hat on, paragraph 2.10 refers to my letter to Appointed Actuaries on AIDS reserving. As with previous such pronouncements, this was not intended to lay down any additional requirements for valuation standards. Its purpose was to indicate the working rule which GAD would be using to judge AIDS reserves so that actuaries could take that into account in choosing their own basis which they considered to be appropriate, and so that they could be prepared with arguments to justify their basis in relation to the sort of questions which they would find GAD asking them. Most appointed actuaries seem to find this approach useful. However, we take note of the criticisms there have been that the advice was perhaps a little late and will endeavour to issue any such letter a little earlier in future years.

There is no doubt that we are in an evolving situation and the most important thing as a profession is to be able to respond quickly to such information as is available at any particular time. Tonight's paper is very helpful in exploring the relative impacts of age on a portfolio and in providing a framework for looking at relevant countermeasures. For our part, as an Institute Working Party, we have begun to give some thought to what more can usefully be said for the benefit of the profession and will be working towards issuing an AIDS Bulletin No. 5 in due course.

Mr J. Altman said:—I am delighted to be able to attend this meeting tonight and to speak briefly to you about the effect of AIDS in Australia.

I received this paper just before I left Australia and I therefore did not have a chance to look at it to any extent before I left but I enjoyed very much reading it on the plane—it helped to pass the time coming over here.

In Australia we have had a total number of deaths from AIDS so far of around 800. Of those 800 deaths, 3% of these have been females; as you can see also in Australia the effect of AIDS among females is fairly insignificant.

Now we have made estimates of the number of HIV positive cases in Australia and the estimates are spread over a fairly wide range. The doctors and the statisticians have come up with figures of between 15,000 and 50,000. The latest group working on AIDS projections in Australia through the Australian Institute have come up with a much narrower range of somewhere between 18,000 and 31,000. We have not looked at any regional differences in depth because the figures in Australia do not really justify those sorts of analyses, but we have developed a projection using the Wilkie model in conjunction with parameters which are applicable under the Australian experience. We have chosen, rather than come up with one particular standard or recommended basis, three scenarios involving varying assumptions of the average population as a proportion of the total population and we call these three scenarios a low, a medium and a high set of figures and scenarios. For each of these we have produced rates of extra mortality from AIDS by age and for calendar years, for about 20 years ahead.

I tried on the plane to do some back-of-envelope calculations to compare those figures, which have only very recently been published, with the Extended R basis and to the extent that I was able to get any meaningful figures, it seemed to me that our high basis was pretty much equivalent at young ages to the Extended R that the Research Group have talked about, and our medium basis is fairly close at the higher ages to your Extended R. At this stage I am afraid that I ran out of envelopes.

We do not have the same extent of legislative control in some aspects that you have (the President referred in passing to your regulation of financial intermediaries) but we do have some regulation and we do have an anti-discrimination law that has coloured the approach we have taken to AIDS underwriting. We have tried to marry the two perhaps conflicting requirements of the insurer's right and necessity to be able to underwrite for the risks which appear important with the need, if the community has expressed through the anti-discrimination legislation, of not being discriminatory in a sense which offends community standards. Now this is a very difficult question and in fact our anti-discrimination legislation does have a specific exclusion in the area of discrimination for life insurance and superannuation, provided that any discrimination which is exercised in those areas is supported by published and reliable statistics. That of course, begs the question of what reliable statistics are and we have ongoing debates with the anti-discrimination bodies to satisfy them that our practices are reasonable. What I am trying to get across is that there is a process of consultation between the life insurance industry and the Government as represented by an organisation called NACAIDS (The National Advisory Council on AIDS) on which sit Government and various community representatives. Through that consultative process there has been agreed a code of conduct on all life offices in relation to underwriting for AIDS involving a standard questionnaire to all insured, asking them to certify six or seven statements are applicable to the insured whether female or male. There is a single question which simply says "I certify that none of the following statements apply to me" and there follows statements such as "I have not been tested for the presence of HIV antibodies"; "I have not had a blood transfusion since 1982"; "I have not engaged in male to male sexual activity"; "I have not used IV drugs", and there are a few others of that sort of nature. If the insured is prepared to sign, to the effect that none of those statements apply to him or to her, then that is satisfactory for underwriting purposes, at least small cases up to a particular limit at which stage the offices tend to ask for HIV testing. That limit is currently around the level of 200,000 Australian dollars.

Most of the offices are abiding by this code of conduct. It is not mandatory, but any office that chooses not to use this or to deviate from the code of conduct is answerable to the Anti-Discrimination Board and to the community and is quite likely to get some unfavourable publicity. There is a community pressure on offices to observe that particular code of conduct.

The other aspect of course is that the answers to all of these questions are guaranteed confidentiality within the offices, and offices have set up various procedures to ensure that confidentiality.

Exclusion clauses, which are also referred to in Appendix 3, are fairly common in group business but fairly rare in individual business. Interestingly, some offices have been offering disability cover based on a choice of either full cover with a higher premium, or an AIDS exclusion with a lower premium. The suitability of this type of approach is currently being strongly debated in the profession and in the industry and there are some very stong views held

on both sides.

There has not been any notable increase in premium rating since the AIDS question has been around.

Mr F. Rowley, F.I.A. said:—Let me start by thanking the Research Group for a very powerful piece of research; this paper will undoubtedly open many eyes, here and overseas, by demonstrating so vividly the scale of the possible effects of the AIDS epidemic on a with-profits fund.

The Research Group have deliberately and understandably stayed clear of recommending any professional course of action. I would like to comment on the possible approaches an office might take to the recovery of the excess cost of claims resulting from AIDS through variations in the calculation of asset shares.

The Government Actuary, in his letter to Appointed Actuaries of 7th December quotes, and not surprisingly endorses, the recommendation of the Working Party that a prudent reserving basis should now take into account the Extended R projection. He points out that this would make implicit allowance for a moderate heterosexual epidemic.

If this epidemic does not materialise, I believe the paper shows that a strong office projecting an experience along the lines of graph 701 might hope to ride out the storm without cutting bonuses on account of AIDS at the cost of a permanent reduction in the estate and some transient changes to term assurance rates. This is Method 1 of Section 4.4 and I will not discuss whether it would be wise to follow it, except to say that it seems extremely unlikely, if not impossible, that there will be no heterosexual epidemic. If it does materialise, the asset/liability ratios for the model office continue to decline, with inevitable consequences even for the strongest of offices. An office, therefore, which does not wish to hold its bonus rates in this way (at the expense of the estate) will need to consider who should pay and when they should start to pay. This course of action is represented by Method 2 in the model office.

If I read the paper correctly, Method 2 avoids cross-subsidies between different generations of policyholders and, by using experience mortality in the asset share calculations, distributes excess mortality losses in relation to the death strain at risk within each generation and class. This is one way of proceeding and some offices may view this as equitable.

It will not be possible, however, to treat losses on non-profit business in this way and in any case some offices may take the view that it is fair to spread the cost more evenly over a greater proportion of the policyholder body. Some do this already.

This is easily done by reducing the crediting rate in the asset share calculations by an amount equivalent to the excess claims cost. The authors do not model this Method 3 precisely, but the order of magnitude can be seen implicitly in one of the sensitivity tests. This method as I said earlier, would start to recoup the costs earlier than Method 2 and so mitigate the effects on the assets/liability ratios and it would have been interesting to see the process worked out precisely, although I am sure it would be more difficult to model it. I suspect, however, it may be closer to the normal practice than Method 2.

Clearly, what will matter in practice is to keep a close eye on the nature of the epidemic and its spread outside the high-risk groups. In terms of bonus distribution in the model office, the differences between the R basis and the Extended R basis will start to become marked in around 10 years time. No doubt much more evidence on the wider spread of the disease will be available by that time, thanks partly to improvements in data collection.

I would not wish to finish with an impression of complacency. The spread of AIDS to the wider community has a great and much more immediate effect on pricing, and again the paper illustrates the scale of this. With the enormous sensitivity of the projections to human behaviour, and the prodigious volatility of that factor alone, it is an unenviable, but nonetheless critical task to take a view on the subject and we must take it now.

Mr J. Lockyer, F.I.A. said:—In the *Sunday Times* of 18th March 1990, there is an article by Michael Flamento; he was an AIDS Analyst in the US Commission on Human Rights and therefore presumably something of an expert on the subject. Flamento in this article argues, quite cogently, that all these gloomy prognostications of heterosexual epidemic are quite bunkum. Can

we forget entirely about the problems of heterosexual spread in AIDS and just concentrate on the other areas? It is a tempting thought, but then some other people who are also experts on the subject, say "yes, heterosexual spread is becoming a problem" so, who do you believe? Probably the fact is that both of them have more than a germ of truth in what they are saying. There is plenty of evidence in the Third World to show that heterosexual spread, that is spread between people with no other adverse factors, can expand rapidly, but the fact is that in this country there is yet to emerge any significant numbers of truly tertiary heterosexual spread.

This does bring me on to a comment on paragraph 2.2 of the paper where the Institute more than comes in for a little, I would have to say very gentle, chastisement, on the fact that we do concentrate on the homosexual element of the epidemic. This has caused very clear comment. This is a simplification, or maybe one should say over-simplification of reality and this is something of course of which we are very well aware, but even if we had developed a more complex model there was too little reliable information regarding all the necessary parameters to make the results realistic.

The tempo in paragraph 2 again seems to indicate that the proportion of homosexuals amongst the HIVpositive means that their influence upon the future course of the epidemic will reduce. This could be misleading and if we take for example the haemophiliacs, we know that they are probably fairly comprehensively documented in most figures. We also know that if you do read *Gay Times*, you will realise that there are a lot of people advising you not to go for testing and one of the reasons is the implications for insurance. There is a possibility that amongst those that are known to be HIV positive, the homosexual group are under-represented.

In the work which we have done within the Working Party, we have frequently been bedevilled by the fact that the information which we have had about the various factors which are critical to the epidemiological model, has been conflicting, and sometimes downright contradictory, even if there has been any information at all. Now as Mr Daykin has already said, with the benefit of hindsight and also a little better knowledge about the epidemic itself, the work which we did originally was really too conservative. Nevertheless the model did permit the study of a range of outcomes from a set of plausible assumptions. I think this is where the work of your own Working Party is extremely valuable.

We have done a certain amount of, if you like, "what if" work based on the epidemic itself. What your Working Party has enabled us, and maybe yourselves to do, is then take that a stage further and show what the bottom line is to a life insurance company. This also alludes to the work which we plan to go on to within our own Working Party. Again we hope to look at the problems of, possibly, under-reporting, to try and identify the extent of which under-reporting is currently taking place and then maybe to recalibrate our model, again with projections which better calibrate what we have seen already.

Mr Norman Gould, *closing the discussion, said:*—Three years ago, when I joined the AIDS Working Party, I hoped to find someone with a model office who would help me look at just the problems addressed by the authors. I approached several offices without success. The mortality changes could not affect the traditional office enough to be worth modelling. Tonight's paper and discussion should have been sweet music to my ears and I would like to thank them for all their work.

The authors remind us of the enormous difficulties in projecting the spread of AIDS. Unfortunately due perhaps to limitations on time and the size of the paper, the authors then look too briefly at the problems and stick to the Institute of Actuaries Working Party projections.

While we have little idea of how AIDS will spread amongst our heterosexual policyholders, it certainly will. Lack of parameters does not mean lack of a problem. AIDS is not purely a homosexual disease.

Mr Pike referred undetermined HIV positive cases to the homosexual or bisexual group. Of the undetermined cases he mentioned, a lot of them are females; I think it is unreasonable to assume that they are in that category, perhaps they are more likely to be intravenous drug abusers and as many of these may be prostitutes they represent an agency for spreading the virus to heterosexuals.

The Research Group made a valuable start. I see a need for studying much more extreme

mortality assumptions as we look out into the next century. Parts of Africa state that 20/30% of their sexually active males are HIV positive already. Believe that if you wish—I don't know how you get statistics in Africa, but is 10% HIV positive an impossible scenario for this country? Less than half that would give ten times the AIDS mortality we get from the Extended R basis. Using Extended R as an extreme assumption, probably enabled the authors to avoid the attentions of certain elements of the popular press—a very worthy aim. Why should we look further?

The Government Actuary drew attention to offices with a higher risk profile. I feel sure we should look further, particularly if we want to continue to issue long-term guarantees on premiums for a high risk business.

Other authors have published much gloomier forecasts. Regardless of the motives for producing these estimates, and the quite unfair criticisms of others, including the Institute Working Party, it might be worth running our model just to see what similar ultimate AIDS mortality would do. I leave others to feed DTI returns into the model against a range of these assumptions.

Particular thanks should go to Mr Altman for his outline of the Australian scene. If you felt the Australian code was a bit unacceptable to us, you should get hold of the South African equivalent, it is quite enlightening.

I think I have gone on too long and hope I have only encouraged the authors and others to continue with the work.

Mr A. S. MacDonald said:—My comments will be brief and the authors will exercise their privilege to reply to most of the comments made in writing after seeing the transcripts of the meeting.

I think I speak for all the authors and thank you for a very interesting and well informed discussion, and in particular would like to say how pleased we were to see the members of the Institute of Actuaries AIDS Working Party up here. It will be clear, from reading our paper, just how much it owes to their work as indeed does all work on AIDS in the United Kingdom.

First of all, I could review briefly what it was that we tried to do. We decided to take the Institute of Actuaries Working Party's mortality rates and use them to try to drive a rough measure of the overall financial position of an office in the presence of AIDS. Given all the uncertainties we certainly did not feel justified in aiming at anything other than a rough measure, and we feel we were reasonably successful in reaching some order of magnitude figures, which we hope will be of use and possibly give some comfort to actuaries in mutual offices.

The other aim was to provide a computer model of more general use to actuaries and to distribute this in conjunction with any research paper, and judgeing by the response tonight, possibly a computer programme of that nature needs a little bit longer time than a written paper to obtain an explicit response. I am pleased it appears to be regarded as useful and it will be interesting to see what the results are from using it in the future.

The other reason for distributing a computer model along with the research paper, is to allow others to investigate points which we have not considered.

Professor Wilkie gave us an interesting survey of some of the recent statistics and this highlighted one of the problems faced by any group working in the field of AIDS at the moment, which is that your projections are bound to be out of date almost as soon as you have completed them. There was one major switch in the middle of preparing this paper which was brought about by the new projections in Bulletin No. 4. If these projections are also now proving to be a little bit wide of the mark (I do not say that in any critical sense) then we accept the criticism that we have used these projections in our paper but we really did not see what else we could do.

I would like to comment briefly on one or two of the technical points which were mentioned in the discussion, although leaving most of them until there are written comments afterwards.

Professor Wilkie criticised our use of asset/liability ratios while studying term assurance business and I would fully agree with him if asset/liability ratios were all being used; it did not strike us as a suitable measure of the impact of AIDS on term assurance business. We looked also at the effect of AIDS on term assurance premium rates and we regarded that as the principal, or our principal measure of the impact of AIDS on that class of business, but, bearing in mind that we were producing projections for a combined office which included some term assurance

business, we left in the sub-section of asset/liability ratios for term assurance business so that the contribution of that sector of the business to the combined office as a whole could be seen. As was commented, it was largely swamped by the assumed predominance of low-cost endowments in the later years.

It would indeed be interesting to look further at term assurance offices. We certainly admit that we wrote the paper from the perspective of a large mutual office and a large mutual office writing low-cost endowment business rather than traditional endowment business at that. This might have made it typical of many Scottish offices, if not typical of United Kingdom offices as a whole. That is an area in which much interesting research remains to be done.

Mr Pike asked one specific question, if the limitation on the net premium had been included in Section 5.3, and the answer is "Yes". He expressed the wish that we should have looked at maturity proceeds to consider things from the policyholder's point of view rather than the offices' point of view. I think we did make some attempt to do this. In graphs 509 to 512 we looked at the emerging terminal bonus rates on the with-profit classes and we regarded these classes of business as being a suitable measure of the impact of AIDS on policyholders.

Mr Forfar drew a conclusion for us, which we were too tentative to draw for ourselves, that the with-profit fund has the flexibility to deal with the impact of AIDS as measured by the Institute of Actuaries' current projections, and we would agree with that. I think our conclusions along those lines would be that with-profit funds may have other problems, but they do show great robustness under the impact of AIDS and the interesting result, perhaps which this paper has produced, is to show in what position a with-profit fund would have to be in order to be tipped over the brink by AIDS alone. Whether you derive comfort from that as some did, or great despair as others did, is a matter of how you view the future.

Mr Rowley mentioned an alternative method of distributing the losses due to excess AIDS mortality across different generations of policyholders. As he said, the methods we looked at were only one or two of many methods, others could be used. He made one point which puzzled me which was that by reducing the rate of return for deriving to asset shares, the losses would be recovered earlier than under Method 2. I may have misinterpreted his statement but I am not sure if that is true because under any method where the losses are recovered by adjustment to asset shares, the office does not actually benefit from this until the policies have matured and the excess assets which have been deducted from the asset shares belong to the office after the corresponding liability has gone off the books.

That, I think, is all I would like to say at this stage. We will need to study the transcript of the discussions in detail to make our final comments, but I would like to thank you again for your discussion and for the very interesting and helpful contributions you have made.