ACTUARIAL ASPECTS OF PHI IN
THE U.K.

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1. INTRODUCTION

"Shut, shut the door, good John! fatigued I said,
Tie up the knocker; say I'm sick, I'm dead."

Alexander Pope, *Epistle to Doctor Arbuthnot*

1.1 SCHEDULE 1 of the Insurance Companies Act 1982 defines Permanent Health Insurance (PHI) as a class of Long Term insurance business being ". . . contracts of insurance providing specified benefits against risks of persons becoming incapacitated in consequence of sustaining injury as a result of an accident or of an accident of a specified class or of sickness or infirmity being contracts that:

(a) are expressed to be in effect for a period of not less than five years, or until the normal retirement age for the persons concerned or without limit of time, and

(b) either are not expressed to be terminable by the insurer, or are expressed to be so terminable only in special circumstances mentioned in the contract."

1.2 The fundamental features of PHI as developed in the U.K. are therefore:

(a) It provides *specified* benefits in the event of ill health.

(b) Cover may not be cancelled by the insurer (except under special circumstances described in the policy document) and hence the insurance is 'permanent'.

1.3 For individual contracts the premium is normally guaranteed throughout the term of the policy and it is perhaps surprising that PHI should have developed in this way given that claim rates are so difficult to predict. Indeed new developments in PHI may well concentrate on products where the risks to the office (and the need to charge the policyholder for the risks) are reduced.

1.4 The combination of fixed long-term guarantees, uncertain risks and the need to establish adequate reserves against these risks poses a complex and difficult challenge. In this paper we explore the main issues to be faced by the actuary.

2. THE MARKET

2.1 The size of the PHI market in recent years can be seen in Table 1.

Table 1

(a)	Year	New Yearly Premiums (£ million)	New Single Premiums (£ million)
	1980	12·00	·76
	1981	12·70	·67
	1982	13·30	1·02
	1983	19·00	·64
	1984	20·20	·25
	1985	28·90	1·20

(b)	Year	Yearly premiums in force at the end of the year (£ million)	Estimated number of lives covered (thousands)
	1980	46·8	1,540
	1981	54·1	1,520
	1982	66·7	1,550
	1983	100·0	1,930
	1984	111·7	2,220
	1985	147·0	3,060

Source: ABI Statistics.
N.B. The 1983 statistics included for the first time the business of a major office in this field, and the 1985 statistics included a re-classification from general to long-term business for one office.

2.2 Most of the above is Group rather than Individual business, and it represents a very small percentage of the total new business production of the U.K. Life Insurance Industry. At 31 December 1985 there were 272 Insurance Companies authorized to write PHI business, which represents the majority of those authorized to write Long-Term business. The number of lives covered is a small fraction—under 15%—of the working population and it may be asked why PHI has achieved such a limited penetration, since arguably an individual has just as much a need to insure himself against the financial consequences of long-term disability as he has to insure against his death. Reasons for this could be:

(a) PHI is seen by many offices as a complicated and expensive product to administer and market, and furthermore profits are uncertain and likely to emerge in the long-term rather than quickly. Whilst new business in other areas (e.g. mortgage related business and pensions) remains buoyant there may be little incentive to devote resources to developing PHI business.

(b) Because PHI generally requires more detailed underwriting than many life insurance products a broker or salesman may be reluctant to promote it. The delay before the office is able to accept the PHI risk and the problems involved in returning to the proposer for more information may in the eyes of many intermediaries make it a difficult product to sell.

(c) The relatively low premiums charged for PHI mean that the commissions

paid to agents and salesmen are small when compared with the commissions available from the sale of saving plans.

(d) Many offices selling PHI policies have seen the market for this product as being professional people in the higher income bracket and have avoided lower income occupations because of the lower average policy size, and concern over possible adverse claim experience.

(e) A substantial number of individuals may feel they are adequately covered by their pension scheme.

3. CURRENT PRODUCTS

3.1 Individual Conventional Policies

The traditional individual PHI policy provides a regular income during disability ceasing at the end of the policy term. Normally the policy term is such that the policy runs to the insured's 60th or 65th birthday. Benefits commence to be paid after the insured has been disabled for a given deferred period (common deferred periods in the U.K. market being 4 weeks, 13 weeks and 26 weeks). In exchange for these benefits a regular level premium is payable throughout the term of the policy. The fundamental feature of the product is that the benefits and premiums are fixed at the start of the policy and remain guaranteed throughout its life.

It has often been argued that this form of premium rate guarantee is inappropriate for PHI contracts, as future experience is impossible to predict reliably, and external factors could give rise to a deterioration in claims experience. As the pace of change in society accelerates, it becomes even more difficult to envisage social and economic conditions in 20 or 30 years time, and their effect on attitudes to work. With competitive pressures also forcing premium rates downwards, it is perhaps even harder nowadays to justify premium rate guarantees.

3.2 Increasing Benefit Policies

In order to provide some protection for the insured against inflation a variation on the standard contract is to offer some form of increasing benefit. The contract can provide that once a claim commences the benefit will increase by a defined amount each year (often 5% or 7·5%) or sometimes be linked to a Price Index. The premium for the policy can be level but commonly will increase at the same rate as the benefits during claim. Before claim there is also scope for alternative designs. The policyholder may be offered the option to take out a series of policies, at the premium rate applicable at the date each incremental policy is effected. Alternatively the level of cover can be increased at the same rate as benefit during claim. Whatever design of benefits is selected (and perhaps the simplest to market is one where premiums and benefits both before and during claim increase at the same rate) the essential feature of the product is that the terms are guaranteed throughout the life of the policy.

3.3 *Renewable Policies*

Another variation on the basic product is to offer a series of short-term (at least 5 years) renewable policies. Benefits would be payable until a pre-determined age (e.g. 60 or 65) or until disability ceases, if earlier. At the end of the term of each policy the insured is able to effect without evidence of health a further policy at the rate applicable to his then age and on the terms then offered by the office. Some versions include increasing benefits either before or after claim, or both, and the ability to increase cover at renewal. This design offers the office protection against a catastrophic deterioration in claims in that premium rates can be increased at renewal. However, there is a danger that if premiums are increased because of bad experience, the policyholders in good health will lapse and take out policies with other insurers, and so the subsequent claims experience will deteriorate further. The premium increase will be insufficient to cover the subsequent adverse experience, and further premium increases may repeat the process. Nonetheless, the risk of inadequate premium levels is less than if the terms are guaranteed throughout.

3.4 *With-Profits Policies*

It is possible to offer PHI on a with-profit basis. The argument for this design is that although a substantial contingency margin still needs to be charged in case morbidity or investment experience is unfavourable, this can be returned to the policyholder as bonus distributions if it is not needed. The product should therefore offer better value to the policyholder than the non-profit design. With-profits policies are not however very common in the U.K.

3.5 *Unit-Linked Policies*

A radical and recent development in Individual PHI products in the U.K. has been the introduction of a unit-linked PHI product. In essence this product operates much as a Flexible Whole Life or Universal Life policy. The policyholder's premiums after deductions for expenses are invested in unit-linked funds and units are regularly cancelled by the office to pay PHI risk premiums. The risk premiums are calculated as the probability of a claim arising in the month (or such period as the office uses) multiplied by the value of an annuity to age 60 or 65 which ceases on death or recovery from disability. As with Flexible Whole Life Plans the level of PHI cover is regularly reviewed in the light of the premium, scale of morbidity charges and unit fund performance. The office retains the right to vary the scale of morbidity risk premiums to reflect favourable or unfavourable morbidity experience. On death, surrender or at the end of the policy term the policyholder receives the value of his unit fund. This design has advantages for both the office and policyholders and in the future may well supersede the more traditional design of PHI.

For the office:

(*a*) The profitability of the product is more certain than for the traditional product. Investment returns and overall morbidity experience (both

critical to the profitability of traditional contracts) will have much less effect, and profits can be allowed to emerge much earlier.

(b) The ability to reflect overall morbidity at policy reviews and in morbidity charges greatly reduces the need for large contingency loadings in premium rates and valuation bases.

(c) The product can easily be packaged with life cover and an element of savings in a single universal life plan. Thus several insurance needs can be met from a single plan, and it should be possible to achieve a high average premium.

For the policyholder:

(d) Favourable overall morbidity experience will be reflected in increased benefits/lower premiums at policy reviews. Similarly the policyholder will benefit if the office achieves a better investment performance than used in the original costing of the plan.

(e) Because the need of the office to establish reserves against long-term guarantees is reduced the premium rate charged should be competitive with that for a traditional policy issued by a comparable office.

(f) If the policyholder wishes to lapse his policy he will receive the value of his unit funds (whereas for the traditional design of PHI it is not common for offices to pay a surrender value).

(g) The PHI cover can be part of a single unit-linked plan providing life cover and savings in addition.

3.6 Keyman Policies

There is a small market for 'Keyman' policies taken out by companies to cover the risk of a key employee becoming disabled. These contracts are usually for 5 or 10 years, with the benefit only being payable for 1 or 2 years, to cover the company until it is able to recruit and train a replacement.

3.7 Group Policies

PHI for groups of employees is now generally conducted on the basis of recurrent single premiums rather than regular annual premiums and level or escalating benefits can be provided. As with group life contracts it is common for the larger groups to express the sum of single premiums for members of the group as a percentage of payroll (assuming that sickness benefits are related to salary) and to guarantee this percentage for a period, often 3 years, provided there are not fairly drastic changes in the age/sex distribution of the workforce. Insurers generally allow an amount of 'free cover' (i.e. cover on an individual scheme member up to a specified level without requiring medical evidence on that individual) depending on the size of the scheme. A continuation option, allowing employees who withdraw from service to effect on individual policy without evidence of health, is usually included. Because Group PHI rates are in general

very competitive many offices see the market as one in which it is difficult to achieve consistent profits, and some offices have withdrawn altogether, or are only prepared to offer cover to existing Group pensions clients.

4. POLICY CONDITIONS

4.1 *Definition of disability*

The definition of disability most commonly adopted in the U.K. is based on the insured being unable to follow his own occupation and not following any other occupation. Other definitions of disability are possible which would result in greater or fewer numbers of claims. These include:

(*a*) Unable to follow own occupation

(*b*) Unable to follow own occupation for a period of 2 years and thereafter not following any other occupation

(*c*) Unable to follow any occupation for which the insured is fitted by training or social status

(*d*) Unable to follow any occupation.

Marketing considerations will play a significant part in the choice of definition of disability, but its effect on claims must be reflected in the pricing basis.

4.2 *Replacement ratio*

The size of the benefit relative to the income of the insured is probably the most critical element in an office's claims experience. All possible steps must be taken to ensure that over-insurance does not occur, and a clause will usually be included to limit the income insured if it is excessive. We discuss the effect of this in § 14.

4.3 *Age at entry*

There is a significant risk of selection against the office for new policies taken out at older ages. It is therefore normal to impose an upper age limit of 50 or 55 on new policyholders.

4.4 *Rehabilitation*

A rehabilitation clause is a common feature of most modern policies. This permits the disabled policyholder with the consent of the office to take up some form of employment (e.g. part-time or light duties) whilst continuing to receive a reduced PHI benefit. As well as being of social benefit to the insured in helping him to recover the work habit an enlightened attitude to rehabilitation benefits can in the long term reduce the office's claims costs. To operate the rehabilitation clause successfully and sympathetically the office needs to review claims in some depth and it is interesting to note that one of the leading PHI offices has recently announced the employment of full-time disability counsellors to visit and assist claimants in the process of rehabilitation.

4.5 *Miscellaneous*

Other policy conditions which will vary from office to office include:

(*a*) Residence—many offices require the cover to cease if the policyholder takes up permanent residence outside a specified area (e.g. Europe and North America).

(*b*) Claims procedures—this will cover the evidence required by the office before it admits a claim and the continuing evidence of disability required whilst the benefit continues to be paid.

(*c*) Occupation—many offices require notification of a change of occupation and reserve the right to terminate the contract.

(*d*) Exclusions—cover may not operate if disability is due to war, self-inflicted injury, alcohol or drugs, certain hazardous pursuits, or pregnancy (although many companies do not exclude disability lasting more than 3 months from termination or childbirth).

(*e*) Linked claims—where a claim ceases and then recommences within a very short period (commonly within 13 weeks) it is common for benefits to resume immediately without the requirement for a further deferred period.

(*f*) Multiple insurances—to protect itself against the policyholder who obtains excessive cover by effecting a larger number of policies with different insurers the office may impose an overriding maximum benefit linked to the PHI benefits which the policyholder has with other offices.

5. PREMIUM RATING

5.1 *Morbidity*

In the case of the traditional product the office is offering to provide cover on terms that will remain fixed against a risk that is almost certain to change during the term of the contract. Morbidity is subject to much greater fluctuation than mortality, and so this guarantee is more onerous than it would be for term assurance. The situation is compounded by the fact that most claims are likely to arise in the final third of the lifetime of the policy and so the guarantee remains significant over a very long term. For the unit-linked product the risk to the office of changes in morbidity experience is clearly less onerous since it can review the scale of morbidity charges. However, even with this product the actuary and policyholder will wish to avoid very substantial and radical changes to the scale of charges (and hence level of benefits) provided.

For both traditional and unit linked products the actuary will therefore introduce an element of conservatism into his pricing basis taking into account the following factors:

(*a*) *Variability*

Morbidity experience between different offices can vary very substantially. The CMI investigation for the period 1972–75 compared the experience of different offices by showing the ratio of actual claims (*A*) to claims

expected (E) on the basis of the Manchester Unity AHJ morbidity table. For policies with a deferred period of 26 weeks the ratio A/E ranged from 15% to 28%. The 'heaviest' office therefore experienced nearly twice the level of claims of the 'lightest' office.

(b) *Marketing*

The marketing policy of the office will have a major impact on claims levels. For example an office operating through insurance brokers only and selling to a narrow range of individuals in a limited number of low risk professions would be almost certain to have a different experience from an office selling via a direct sales organization to self-employed individuals in a wide range of occupations.

(c) *Policy conditions*

The policy conditions adopted by the office and discussed in § 4 above will be critical to the experience of the office. Of these the single most important condition relates to the level of benefit that is permitted relative to the income of the policyholder. Allowing too high a level of cover is virtually certain to undermine even the most cautious of pricing assumptions.

(d) *Underwriting*

The underwriting policy adopted by the office can greatly influence experience. A liberal policy on initial acceptances and when claims are admitted and reviewed must be reflected in the morbidity basis adopted.

(e) *Selection*

From the evidence available initial selection for PHI policies appears to operate in a very different way from life assurance. This may significantly affect the experience of an office with a young portfolio and the actuary designing premium rates is faced with the problem as to how or indeed whether to allow for selection effects. C.M.I. Reports Number 4 and 7 addressed the question of selection but from the data available it was not possible to draw any firm conclusions.

Based on experience in some overseas territories Miller and Courant[9] have suggested the following:

Age range	Coefficient of selection
Younger	Negative
Middle	Neutral
Older	Positive

That is, that at younger ages early claims are actually heavier than ultimate and that only at older ages is there a selection effect similar to that for life insurance.

For the traditional form of contract it is probably reasonable to make no explicit allowance for selection given the substantial contingency margin required in the basic premium. In the case of the unit-linked product however the effect of selection requires more careful consideration since not only is the morbidity charge explicitly stated and an element in

the profitability of the contract to the office but also because of the facility to vary the scale of charges, margins in the premium rate are likely to be lower. An office writing unit-linked PHI business for the first time must carefully analyse its morbidity experience to ensure that selective effects do not cause it incorrectly to review its morbidity charges and policyholder benefits.

(*f*) *Secular trends*

Secular trends may be occurring in morbidity. For example experience may be affected by economic factors and changing social attitudes towards sickness and the making of insurance claims. Over the lifetime of a typical PHI policy it is clearly not possible to predict with accuracy how these factors will change morbidity rates. In some territories an improvement in morbidity at younger ages and a worsening at older ages has been observed. This trend has been called 'the counter-clockwise movement' (because of the effect produced on a graph plotting morbidity rates against age). An explanation of this may be that improving health is reducing claim rates at younger ages but that in consequence there is a greater exposure to risk of lives who are more likely to claim at the older ages.

5.2 *Expense loadings*

As with any other insurance product the loadings in the policy must be sufficient to meet the expenses of selling and administering the product. Any office (but especially an office contemplating entering the field of PHI for the first time) must consider the costs involved in establishing underwriting and administrative procedures for PHI which in many ways will be quite different from those applicable to its life assurance business. To take a simple example if an office's claims review procedures are sufficient to ensure that claims terminate on average one week earlier than its competitors then it will incur lower claim costs, and the difference can be very significant for short deferment period policies, or those with limited benefit payment terms, such as Keyman policies. The introduction and maintenance of such procedures will however represent a significant investment of money and management time on which the office's shareholders (or with-profits policyholders) will require an appropriate return and this must be reflected in the pricing of the final product. Since premium rates will inevitably have to recognize the rates charged by the office's competitors the actuary must consider the probable volume of business to be written and whether the total expense loadings generated will be adequate to justify the initial cost of entering the PHI market.

A particular problem for PHI business is that if the office imposes a reasonable restriction on the benefit/salary ratio then the size of the premium chargeable for much of the office's potential market will be below that which it is economic for the office to collect. One answer to this dilemma is to sell PHI as an element in a package of cover—for example term assurance, family income benefits or possibly medical expenses insurance—in order to ensure an adequate total level

of premium from each sale. An alternative strategy is to concentrate on high earners on whom the office will be able to permit sufficient cover to generate an adequate premium.

5.3 *Taxation*

For taxation purposes PHI is regarded as a separate class of business from an office's life insurance business. The detailed rules are complex but in very broad terms conventional PHI business written by a proprietary office is taxed on the basis of 'profit' excluding investment income plus tax on investment income. Computing 'profit' excluding investment income generally results in a loss which may be offset against the tax on investment income. The net effect of this is that PHI business will be taxed on a true profits basis and thus for pricing purposes gross interest and expenses may be assumed. In the case of a mutual office it has been said that since no 'profits' can be made by a mutual organization then there can be no loss as described above to offset against investment income deducted at source—hence pricing should be based on a net interest gross expenses basis. However it is understood that many mutual offices are for taxation purposes able to treat their PHI fund as an investment of their life fund and thereby ensure that their PHI fund is taxed on the same basis as their proprietary competitors. A review of the premium rates available from offices indicates that mutual offices do not appear to be handicapped in pricing their PHI products.

The taxation of the unit-linked product is at present a little less certain. If premiums are at such a level that at the end of the term the surplus available to the policyholder is likely to be small (because aggregate morbidity charges will have completely consumed unit funds) then arguably the product should be taxed as a conventional PHI policy. Hence the investment income on unit funds will be gross of tax. If however the premium paid is set at such a level that the policyholder can reasonably expect a substantial unit fund to remain at the end of the policy then the contract could be said to have more in common with a unit-linked life assurance policy. If the contract were taxed on this basis then interest on unit funds would be net of tax but the office would be able to obtain tax relief on its expenses. In general it is likely that this latter interpretation will be more favourable for the office, who will benefit from immediate tax relief on expenses, and less favourable for the policyholder whose unit performance will be subject to tax. For an office contemplating a unit-linked product it may be advisable to take specialist tax advice on the product that it wishes to develop. If potential business volumes were thought to be sufficiently large an office could perhaps review its corporate structure and consider the advantages and disadvantages of establishing a specialist PHI subsidiary.

5.4 *Reassurance*

In view of the considerable financial risks the actuary should consider carefully the level of reassurance that is appropriate and the costs involved. The uncertainties may lead an office (particularly one new to the field of PHI) to

reassure a greater proportion of its PHI business than it might consider appropriate for its life assurance business and the level of its free reserves. The expense of reassurance can sometimes be justified not only in terms of the spreading of risk but also from the underwriting advice and support that many reassurance companies are able to provide.

5.5 Solvency Margin

The solvency margin for PHI products is 4% of the actuarial reserves and in profit testing many offices will wish to charge a price for this capital which must be provided by the shareholders or with-profits policyholders.

5.6 Females

The actuary must consider how he will approach the question of charging a higher premium for female policyholders than male policyholders. The normal practice for conventional policies is to charge females a premium rate which is approximately 50% higher than the corresponding rate for a male. This subject was recently considered in a well publicised court case (Pinder v The Friends Provident Life Office) in which the plaintiff, Ms Pinder, claimed that the imposition of such a loading was unlawful under the terms of the Sex Discrimination Act 1975. The insurance company claimed that the discrimination was justified under §45 of the Act which provides that the treatment of a person in relation to insurance is not unlawful if

" . . . the treatment
   (a) was effected by reference to actuarial or other data from a source in which it was reasonable to rely and
   (b) was reasonable having regard to the data and any other relevant factors."

The case centred on a consideration of available data on the relative morbidity of men and women. The judge found in favour of the insurance company and said in his judgement:

"I approached this case with the impression that there was a very heavy factual burden of proof on the Defendants. . . . Having heard the evidence I am quite satisfied that the Defendants have discharged the burden of proof. There is overwhelming evidence that a substantial loading is justified. It is not clear what is the right figure and I do not think that there is such a thing as a 'right figure' . . . The decision as to the actual amount of the 'loading' is ultimately a matter of commercial judgement . . .".

As was highlighted by the above case the evidence available whilst pointing in a particular direction is not really sufficient to give a firm indication of a right level of loading. The actuary must therefore consider the loading to be introduced in the light of the overall strength of the premium basis. There is some evidence from overseas that the additional female morbidity may vary with age and in this context it is perhaps worth considering the results of the investigation made by the commissioner of insurance for the State of New York[12] as a result of a similar sex discrimination case being brought. Results from this investigation are shown in Appendix A. The investigation concluded that the sex of the insured

was an important factor in morbidity experience and that for lives in similar occupations a loading for females was justified.

5.7 *Investment income and matching*

An important factor affecting the profitability of traditional individual PHI policies is the interest rate that will be earned on reserves. The benefits are non-profit and will become payable some considerable time after premiums have been received. Ideally, the investments would match the expected outgo (after allowing for claim terminations), which for a portfolio of business might be a stream of income which would start at a low level and rise to a peak after perhaps 25 years before reducing. Suitable investments would therefore be fixed interest for the appropriate term. As a high level of income is not required initially, low (or even zero, if available) coupon stocks might be considered, although high coupon stocks might offer higher yields. Claims for shorter deferred periods terminate more rapidly, and strictly require shorter term investments, although the effect may not be too great for this type of contract.

The premium basis needs to take into account the yields available on the likely investments over the term of the contract. Clearly any office that guarantees the premium throughout the term of a contract (possibly for up to 40 years) must take a conservative view of future interest rates. In general therefore, most offices can be expected to have a significant interest surplus on this type of contract, although the size of surplus will fluctuate substantially with movements in interest rates. This may be some comfort to the actuary worried that morbidity experience may deteriorate to the point where it exceeds that implicit in the premium basis. In § 10 this effect is illustrated.

For the unit-linked products and Group Single Premium contracts, the risk premiums are designed to cover the risk for a short period, so that premiums will only be held briefly (i.e. during the deferred period) before claim payments start. Suitable investments for the morbidity deductions will therefore be fixed interest or index-linked, to match the expected stream of claim payments, but of a shorter term than for the traditional individual product, and with a requirement for a high level of income. As the premium rates or morbidity charges are not guaranteed for a long period, a less conservative interest rate can be assumed for pricing, and the profitability of the product will be much less sensitive to interest earnings. As the morbidity charges are likely to be obtained by cancelling unit funds, it could be argued that the underlying unit funds should be restricted to long-term fixed interest stocks. However, as the policies carry the ability to review the premium upwards in the event of poor investment performance and there may be a significant investment surplus targeted at maturity, investment in potentially higher yielding funds can be justified.

5.8 *Persistency*

Lapse rates need to be brought into consideration when fixing a premium basis. Early lapses tend to reduce the profitability of the contract. However once initial

expenses have been amortized the lapses may well improve the profitability of the contract (normally no surrender values are payable under traditional PHI policies and hence any reserves on lapsed policies fall to the office). These lapse profits may well provide the office with a modest measure of protection against a deterioration in morbidity. We illustrate the effect of lapses in § 10. For unit-linked type products early lapses are significant in that they will reduce profitability but since on termination the policyholder will generally receive the value of his accumulated unit funds late lapses will not materially affect profitability.

5.9 *Mortality*
The mortality basis selected will not substantially affect the final premium rate but a lighter mortality rate will generally lead to a higher premium rate and hence it may be advisable to anticipate secular improvements in mortality.

5.10 *Competitive position*
A final and in practice most important consideration in premium rating is the market rate prevailing. A comparison of premium rates in several countries, produced by Simon Courant[6] is shown in Appendix B. As can be seen the U.K. market is highly competitive and any company operating in this market will to a very large extent be influenced by the prices charged by its competitors. The fundamental problem as with all insurance products is to design a product that will appeal to the public and at the same time produce an adequate profit for shareholders (or with-profits policyholders).

6. MANCHESTER UNITY METHOD COMPARED
WITH THE INCEPTION/ANNUITY APPROACH

6.1 *Manchester Unity method*
The traditional method used in the U.K. to develop PHI premium rates is known as the Manchester Unity method since the techniques employed are those used by A. W. Watson for his investigation into the sickness experience of this society. This method is based on the concept of a central rate of sickness at age x represented by the function Zx. Strictly Zx may be defined as the average number of weeks sickness per annum experienced throughout the year of age x to $x+1$ by lives who obtain age x allowing for the fact that those who die before age $x+1$ are only exposed for a part of a year. The Zx function can allow for the sickness of different durations e.g.

$Zx^{a/b}$ represents Zx with sickness being defined as disability that has lasted more than 'a' weeks but not more than '$a+b$' weeks.

Unfortunately the standard Manchester Unity sickness table only allows for the duration of disability in a limited way in that all sickness of duration more than 2 years is combined in the function $Zx^{104/All}$.

Premium rates are derived by applying the Zx functions to the projected numbers of lives at risk at each age x in order to calculate expected claims.

6.2 *Inception/Annuity method*

The alternative method which is the standard method used in the U.S.A. and many continental European countries is the inception/annuity approach. In this method at each age the probability of a claim arising is applied to the exposed to risk to establish the number of new disability claims arising in a given period. The cost of these new claims is taken as the product of benefit payable and the value of an annuity payable to a life who falls sick at age x and terminating on death or recovery or the end of the policy term whichever occurs first. The building blocks for this technique are therefore inception rates (i.e. the probabilities of falling sick at a given age) and termination rates (i.e. the probability that at a given age and duration of claim a claim will terminate because of the recovery or death of the policyholder).

6.3 Although simple in concept, the inception/annuity method can be complicated in practice. This is particularly the case in developing the future exposed-to-risk, who will be made up not only of the survivors of current healthy lives, but also of recoveries from future and current claims. In practice, however, at least in the U.K., the inception rates and termination rates cannot be reliably determined or predicted, and simpler approaches can be justified. One approximation that can be used for annual premium level PHI contracts with waiver, where a premium rate is being calculated by formula methods, is to ignore recoveries in calculating the exposed-to-be-risk, and also not to allow for the waiver in the formula.

i.e. AP
per £1
p.a.
benefit
$$= \frac{\sum_{t=0}^{64-x} V^{t+\frac{1}{2}} \frac{l_{x+t+\frac{1}{2}}}{l_x} i_{x+t+\frac{1}{2}} \, a^d_{x+t+\frac{1}{2}:\overline{65-x-t-\frac{1}{2}}|}}{\sum_{t=0}^{64-x} V^t \frac{l_{x+t}}{l_x}}$$

where i_x is the central claim inception rate at age x $a^d_{x:\overline{65-x}|}$ is the value of a disability annuity payable to a life disabled at age x, ceasing at 65, when the policy terminates, and l_x is subject to mortality decrement only. l_{x+t}/l_x in both the top and bottom line are greater than if allowance were made for recoveries and waiver respectively, and the overall effect is roughly neutral. This approximation obviously has a limited usefulness.

6.4 The principal advantage of the Manchester Unity method is its simplicity. For a stable population or for short term sickness benefits it may be an acceptable method. However for use in pricing and measuring the experience of modern individual PHI contracts the Manchester Unity method is unsuitable. This is primarily because it does not distinguish the duration of disability after 2 years

which makes the Zx function vulnerable to the weighted duration in force of the portfolio of policies being investigated. Two offices with identical sickness experiences but with portfolios of different durations generate quite different values of Zx.

6.5 The above point may be illustrated by considering the case of an office which commences writing PHI business. After t years the claims contributing to its $Zx^{104/All}$ will be based on lives disabled for $t, t-1, \ldots$, down to 2 years. Five years later the same $Zx^{104/All}$ function will include claims that have been in force for $t+5, t+4, \ldots, 2$ years. Thus even if morbidity has not changed the values of $Zx^{104/All}$ are almost certain to differ depending on how long the office has been writing PHI business.

6.6 It is possible to construct models to demonstrate the above process, the broad effect of which is to result in values of Zx increasing as the portfolio matures. A simple model (Table 2) based on C.M.I. incidence rates and the DTS table (see § 8) and allowing for lapses showed that for a portfolio of policies sold in the same year values of $Zx^{26/all}$ would develop as follows:

Table 2. $Zx^{26/all}$ *(Sickness of duration more than 26 weeks) in weeks p.a.*

	Policy duration (years)		
Current age (x)	*5*	*15*	*25*
35	·060	·138	N/A
45	·155	·321	·493
55	·563	1·098	1·436
65	N/A	4·211	5·127

As can be seen for this particular model the values of Zx approximately double between durations 5 and 15.

In CMI Report Number 7 the PHI sub-committee also examined this area and commented "the potential magnitude of the problem discussed (above) raises serious questions as to the suitability of the Manchester Unity method for the analysis of relatively immature portfolios of long term PHI business".

6.7 By directly considering claim inception rates and the values of disability annuities the annuity/inception rate approach avoids the dangers of misinterpretation inherent in the Manchester Unity approach. We agree with the view of the CMI Sub Committee that the annuity/inception system "is a logical and technically sound system for long term sickness evaluation", and welcome their decision to pursue the publication of data in a form suitable for annuity/inception techniques. It seems likely this method will eventually supersede Manchester Unity methods.

6.8 The main advantages of the annuity/inception approach are:

(*a*) An office in referring to a standard table will not have to attempt to make *ad hoc* (and rather arbitrary) adjustments to allow for differences in the duration of its own portfolio and that on which the standard table is based. It can thus directly compare its experience with the standard table without

the risk that it may be lulled into a false sense of security (because e.g. under the Manchester Unity method a poorer morbidity experience could initially be masked by a low average duration).

(b) Measuring inception rates and termination rates separately will provide better financial controls and may indicate much more quickly problems in the initial underwriting of claims or in the subsequent review of claims.

(c) The annuity/inception method is readily applicable to virtually all types of PHI, including escalating benefit policies, Unit-linked PHI risk premiums, Keyman contracts and Group Life.

(d) The method is technically superior for valuation, and in particular directly takes into account actual claims in payment.

7. CMI EXPERIENCE

7.1 *Individual*

The latest Continuous Mortality Investigation report on Individual PHI policies was No. 7, produced in 1984 in respect of experience in 1975–78. At the end of that period there were approximately 230,000 policies in force, and 7,735 claims. The report cast doubt on the reliability of parts of the 1972–74 data, reported on in CMI Report Number 4, and further pointed out that as the portfolio of business matured $Z^{104/all}$ would tend to increase assuming no change in the underlying experience for the reasons discussed in § 6. The Committee therefore recommended that upward adjustments to the 104/all sickness rates should be considered, but were unable to quantify these adjustments, other than to warn that they could be substantial.

Table 3 may provide evidence of this effect, although the unreliability of pre-1975 data, and the effect of other factors (e.g. the age distribution in the exposed to risk), make any conclusions tentative. The claims experience of the years 1979–82 has not yet been published, but has been distributed to contributing offices, and the CMI have kindly made this available to us.

Table 3. *U.K. Individual PHI*
Aggregate Experience

Males—All deferred periods
combined—All Ages

Actual/Expected Weeks of Sickness
of more than 2 years Duration
(Manchester Unity AHJ—104/all)

Year	A/E (%)
1972–75	37
1975–78	44
1979–82	51

7.2 Offices might otherwise have been tempted to conclude from Table 3 that

U.K. Individual experience was deteriorating. However, Table 4 suggests that, if anything, inception rates have decreased.

Table 4. *Claim inception rates per 10,000—All ages*

	Deferred 4 weeks	Deferred 13 weeks	Deferred 26 weeks
1972–75	220	50	10
1975–78	231	47	17
1979–82*	192	42	16

* Average of the 1979–82 rates.

Again the numbers are small, and changes in age distribution may be having an effect, although the age specific inception rates shown in Appendix C also have a decreasing trend.

7.3 Whether the deterioration in the $Zx^{104/all}$ above is solely due to the maturing of the portfolio, or whether changes in claim termination experience are having an effect it is impossible to judge. Overall the evidence might prompt the tentative conclusion that PHI individual experience may not have changed much during the 70's and early 80's, and perhaps has improved modestly.

7.4 The above illustrates the limited usefulness of the Manchester Unity method for U.K. Individual PHI premium rates or for measuring experience except in limited situations. The claim inception/disability annuity method was put forward by the CMI as being more suitable, and central claim inception rates were published. The exposed-to-risk used in calculating these inception rates included disabled as well as active lives, thereby slightly understating the true rates (as applied to the active exposed-to-risk), particularly at the older ages. There were relatively few claim inceptions, especially for the longer deferred periods, because of the small numbers exposed-to-risk, but nonetheless these inception rates do provide a yardstick for measuring an office's own claim inception experience, and thereby a basis for premium rating, experience monitoring and valuation. No claim termination rates or disability annuity rates were published, and even though the CMI Committee hoped to do this as soon as possible it must be doubtful whether sufficient claims will be available in the near future to give credible results. The 7,735 claims *in force* in 1978 compares with over 130,000 *terminated* claims during the U.S.A. Disability Termination Study, which is discussed in § 8.

7.5 *Group*

CMI Report Number 8 compared the experience of U.K. Group business with the Individual Standard 1975–78 U.K. claim inception rates from CMI Report Number 7. Unfortunately, as mentioned in the report, most Group business is written on a simplified administration 'unit rate' basis, and this has been excluded from the Group investigation, as details of the exposed-to-risk are not

obtained annually. Consequently the Group experience may not be typical of the rest of the market, and also the volume of data is small, even less than for Individual. Nonetheless, Table 5, taken from the figures presented in the report suggests that Group claim inception experience overall is not too far away from Individual.

Table 5. *Comparison of Group and Individual Standard Claim Inception rates. Deferred period 4, 13 or 26 weeks*

Age	Group/Individual (%)
25–34	82
35–44	96
45–54	123
55–64	131
All ages	116

7.6 Overall the experience is heavier, although not by a very large amount, particularly when it is considered that Group includes rated cases, whereas Individual Standard does not. However, the Group experience is lighter at young ages, and becomes progressively heavier with age. There is no data available to compare termination rates.

7.7 It should be borne in mind that the claims experience of a group scheme depends very much on the main occupations involved and the attitude of the employer to his employees and his PHI policy. There is scope for substantial variation, and this is reflected in the terms that offices' quote, with very large discounts given for favourable schemes.

7.8 The majority of Group business is costed by Single Premium, and the incidence/termination approach is much more suitable than Manchester Unity, both for premium rating, valuing the claims in payment, and monitoring on a regular basis whether the business is profitable. For the last exercise, it may be appropriate to use General Insurance techniques, with Unexpired Risk Reserves and IBNR Reserves, and to include Reserves for claims in payment on a less conservative basis than would be appropriate for valuation, i.e. using realistic rates of interest and claim termination rates that are not over-conservative. Ideally the experience should be broken down by year of claim incidence, in order that trends can be observed. This will ensure that a recent improvement or deterioration in claims incidence is not hidden by an offsetting change in claim termination experience for older contracts. However, these techniques will only be a practical proposition for the few companies with sufficient business to produce credible results.

8. USA DEVELOPMENTS

8.1 *U.S.A. Valuation Tables*

In 1985 a report was submitted to the Society of Actuaries in the U.S.A. from the Committee appointed by the Society to recommend new Disability Tables for Valuation. Their brief had been to develop new disability tables for valuation of individual 'active life' reserves and individual and group claim reserves. The previous table, the 1964 Commissioners' Disability Table had been recognized as no longer being appropriate in a variety of circumstances, particularly for the calculation of claims reserves. It was also considered timely to produce a table which would relate the incidence rates (probability of becoming disabled) and claim termination rates (probabilty of termination of disability by recovery or death) more accurately to the relevant risk factors. For the claim termination study, 20 companies participated, providing experience data on 133,936 closed claims.

8.2 The aim was to develop an experience table involving all the measurable factors relevant to the incidence and termination of sickness. Various factors were tested for significance and for incidence rates the significant factors were found to be:

> Age
> Sex
> Occupation Class
> Deferred Period
> Cause (whether from sickness or accident)

8.3 Claim termination rates were found to be dependent on the same factors, plus Duration from disablement. For some factors however the dependence wore off after a period of time had elapsed following disablement. For example, occupation was only significant for the first 13 weeks following disablement. Similarly, whether the disability had been caused by sickness or accident was relevant only for the first year of disability. The deferred period was only relevant for the first 6 months, and duration of claim was relevant for the first 10 years of disability. These dependencies are shown in Appendix D.

8.4 The Disability Table Study (DTS) Valuation Table claim inception and termination rates are reproduced in Appendix E. The claim inception rates are shown separately for disability caused by sickness and by accident.

8.5 Claim termination rates were derived weekly for the first 13 weeks from disablement, monthly thereafter up to 2 years from disablement, and yearly thereafter. For durations of 2 to 10 years since disablement the rates were based largely on Group Long Term Disability (LTD) experience, and for over 10 years (ultimate) they were based on statistics derived from Group LTD, Individual Waiver of Premium, Social Security, and a special study by one company (there being insufficient Individual data). A comparison of these ultimate termination rates is given in Appendix F, which shows the variation in these statistics, and

also how the termination rates are split between those caused by deaths and those caused by recoveries.

8.6 The tables were developed from experience in the mid to late 1970's. Incidence rates were based on 1976–1979 U.S.A. industry data, with the relationship among occupation classes being derived from the 1976 New York study,[12] which covered U.S.A. experience in the period 1967 to 1973. U.S.A. claims experience in the early 1980's has improved relative to this period, and the table might therefore be regarded as conservative in that respect. Two tables of termination rates were produced, the DTS Experience Table and the DTS Valuation Table. The DTS valuation table was based on the DTS Experience Table but the first year termination rates were reduced to 95% of the DTS experience rates, grading into 100% in the 18th month, in order to include a valuation margin. The rationale behind this form of valuation margin was that the deterioration in experience in the 1970's had been due mainly to a prolonging of early claims, rather than a rise in claim incidence. The valuation margin affects both claim and active life reserves, of course.

8.7 The DTS valuation table was intended to be sufficiently flexible to be modified to allow for different companies' mix of business, and to allow adjustment to reflect the many factors affecting disability experience. Claim incidence rates are compared with those in CMI 7 in Appendix G, and the U.K. individual experience 1975–78 is shown to be generally somewhat heavier.

8.8 It could be argued that a table derived from U.S.A. experience is not appropriate for U.K. business, because of the differences between PHI business in the two countries. It would be preferable if there was a credible U.K. table. However, PHI experience shows great variation even in one country, because of the different approaches by offices to underwriting, marketing and selling, and the variation between U.K. and U.S.A. business could be regarded as just another source of variation, albeit an important one. Indeed, the DTS table is intended to be a base table, which in any event requires modification to take account of differences from the underlying experience such as:

The definitions of occupational class, or special groupings.
Tight or liberal underwriting.
The ratio of post disability income to pre-disability income (the 'replacement ratio').
Prudent claims administration, including rehabilitation programmes.
Geographic concentration of business.
Policy conditions—particularly definition of disability.
Methods of marketing, where relevant.

8.9 The DTS claim termination experience has been constructed from a very large amount of claims data. It would appear to be some time before the CMI will have sufficient claims experience to produce a comparable table, and until then U.K. actuaries may well consider using the DTS table, adjusted appropriately for U.K. Group and Individual premium rates and valuation tables. There may be a

case for the CMI to compare U.K. claims termination rates with the DTS valuation table in future reports, until sufficient credible data is available to construct a U.K. table.

The DTS termination table could therefore be used with modifications for pricing, reserving and monitoring the experience of U.K. PHI business. However, the extent and nature of the appropriate modifications is difficult to determine.

8.10 The early termination rates have the greatest effect on disability annuity values and it should be noted that termination rates in the first two years are derived from U.S.A. Individual (rather than Group) Data, and that U.S.A. Group termination rates are apparently much lower than Individual for this initial period. We do not know the explanation for this, although U.S.A. Individual contracts often have the benefit payment period limited to a few years only, rather than throughout the insured's working life, and this may be a factor. At the Society of Actuaries' San Francisco meeting,[2] it was thought that significant reductions to the termination rates in the first 2 years of claim would be necessary for U.S.A. Group business, and about 50% of DTS termination rates in the first year, and 75% in the second year, was suggested. It would seem prudent to apply an adjustment of this kind if the table is to be used for U.K. business, either Group or Individual. Also, the longest deferred period in the DTS termination table is 90 days, as U.S.A. contracts have shorter deferred periods than in the U.K. Early termination rates tend to reduce as the deferred period is increased, and there may be an argument for reducing the early termination rates for deferred periods in excess of 90 days.

8.11 A practical point when using DTS termination rates is that for the first year they depend on whether the disability is caused by accident or sickness. As the CMI claim inception rates are not so subdivided, some adjustment is necessary. One solution is to assume that the CMI inceptions are caused by sickness and accident in the same proportion as the U.S.A. incidence rates, although there may be grounds for more approximate approaches, particularly for the longer deferred periods.

8.12 *Anderson's method*

This method is referred to by Miller,[14] and can provide a convenient indication of how claims experience compares with a published table where it is not practical to calculate an expected number or amount of claims from the policies in force. It can be applied to claim incidence rates or claim termination rates, and in fact can be used whenever there is a standard table providing probabilities of some event happening. It is necessary to have full information on claims i.e. all the information relevant to the probability in the standard table, and overall totals for the inforce (i.e. numbers of policies, amounts etc). The claims information is used to generate, using the standard table, the 'expected exposed-to-risk' that would give rise to that claim. For example, a PHI claim occurring for a male aged 42, deferred period 26 weeks of £4,000 per annum

would give rise to $1/i_{42}$ numbers of policies and $4000/i_{42}$ benefit per annum exposed-to-risk.

The total, for all claims, can be compared with the total average in force to give an indication of whether experience overall is heavier or lighter than the standard table. Whether the relative experience varies with age, duration etc will not however be revealed unless the in force is so divided. The method can be applied to other areas than PHI, for example mortality experience.

9. VALUATION

9.1 For Individual contracts, most offices use the Manchester Unity method for valuation, but even here the method is somewhat unsatisfactory. It is prudent to adopt substantial margins in the morbidity assumptions compared to current experience to cover possible deterioration due to the maturing of the portfolio, particularly for the longer deferred periods. If further margins for long term rate guarantees are included, the combination could produce very large valuation strains, but still leaves the overall strength of the valuation basis difficult to gauge.

Generally offices adjust M.U. AHJ, but as elsewhere for PHI, there is quite a variation in approach. A flat percentage adjustment is usually applied in all cases, but sometimes the percentage is varied either by age attained or deferred period. Where this is done a lower percentage applies for younger ages, or for longer deferred periods, although usually the same percentage applies to deferred periods of 13 weeks or more, and only deferred 4 weeks or less are subjected to a higher adjustment. Most companies use a higher adjustment for females, reflecting their premium scales. Of 6 companies prominent in the individual market who use a flat adjustment for males, the adjustment varied between 60% and 80% of Manchester Unity AHJ for Deferred Periods of 13 weeks or more, with the average being 70%.

9.2 Although 70% is higher than the CMI experience for sickness over 2 years (as shown on page 16), the uncertainty over the effects of the maturing of the business, and the necessary margins to cover long term rate guarantees, would suggest that it may not be prudent to hold less than 70% for deferred periods 13 weeks or more, unless it is believed that the office's morbidity experience will be significantly lighter than that of the CMI.

9.3 Theoretically the Manchester Unity method when used for reserving would not give rise to an explicit reserve for currently outstanding claims, since the overall reserve for future claim payments is derived from the total in force (including current claims). This produces the anomaly that for 2 identical portfolios of business where 1 portfolio had no current claims, and the other had every policyholder as a claimant, the overall reserves would be identical. Perhaps because of this unsatisfactory feature, most offices do in fact hold an additional explicit reserve for outstanding claims. This makes the valuation basis stronger than is immediately apparent. Also, many offices use a very low valuation rate of

interest, lower than the premium basis, and much lower than is currently being earned. These factors make it difficult to assess the strength and adequacy of overall Individual Reserves, particularly for the conventional contracts.

9.4 For Single Premium Group Contracts, most offices hold a proportion of premiums plus a reserve for outstanding claims. Approaches vary for the oustanding claims reserve, some companies holding an annuity subject to mortality only, some allowing for recoveries also, and others holding a number of year's claims payments. To calculate a disability annuity is the most satisfactory theoretical solution, but this is not common perhaps because of the uncertainty surrounding the values of termination rates, and also because the reserves may not be very large compared with an office's total reserves. Disability annuity values are shown at the end of Appendix E, and it is interesting to note how rapidly the annuity values increase over the first year or two of claim.

10. CASH FLOW PROJECTIONS

10.1 In this Section we illustrate the cash flows arising from a conventional individual PHI policy. As for life assurance products such profit testing techniques shed light on:

(a) the profitability of individual policies.
(b) the sensitivity of the profitability to variations in experience.
(c) the pattern of cash flows and financial strains involved.

10.2 The cash flows arising from a policy may be discounted to provide a convenient measure of the pre-tax profitability of the contract. In the example in Appendix H the present value of gross profits (PVP) discounting at 15% is 118% of the annual office premium. The assumptions used in Appendix H are intended purely for illustration purposes and in practice (because of high expense levels or poor morbidity) many offices may not be able to achieve this level of profitability. The actuary will need to ensure that the assumptions used are appropriate and to assess the effect of variations.

10.3 The sensitivity of the result to changes in the assumptions can be examined by considering the effect on the PVP figure of changing one of the assumptions and keeping the remainder unchanged. The effect of a change of 25% in a key assumption is illustrated in Table 6 (as in Appendix H we have used a discount rate of 15%).

In practice more extensive sensitivity tests would be made (e.g. if morbidity rates are increased then it may be appropriate to take account of the effect this may have on expenses). However the above does reveal the significance of the various elements of the experience basis. In particular it demonstrates how a poor morbidity experience can be masked by good investment performance—an office which does not realize that it is in this situation may be exposed if interest rates begin to fall.

10.4 As can be seen from Appendix H the active life reserves build up to very

Table 6

Revised assumptions	PVP as a percentage of the office premium (%)	Percentage change in PVP (%)
Basic run (no change)	118	—
Interest rate 9·375%	155	+31
Claim inceptions increased by 25%	71	−40
Termination rates reduced by 25%	86	−27
Claim inceptions increased by 25% and termination rates reduced by 25%	30	−75
Lapse rates in the 3rd and subsequent years 6·25%	119	+1
Lapse rates 12·5% year 1, 9·375% year 2 and 6·25% thereafter	112	−5
Mortality of 100% of A 67/70 Ultimate with an allowance for selection	118	—
Revised renewal expenses of £12.50 per policy plus 2·5% of premiums plus £3.125% of benefits paid (the £12.50 inflating by 5% p.a.)	110	−7

substantial amounts relative to the office premium (in the example up to 6 times the current premium). Because of its size the active life reserve is therefore critical to the solvency of the office's PHI portfolio. It is unfortunately one of the most difficult elements in the valuation basis to establish since it is impossible to predict with confidence the pattern of future morbidity.

The general pattern of claims paid out shows a slow increase—in the table in Appendix H the total of benefits paid in the first half of the term (i.e. $12\frac{1}{2}$ years) is under 20% of the total benefits paid over the full 25 year life of the policy.

The average disability annuity values are, perhaps surprisingly, relatively stable. Whilst the weighted average duration of claims in force is low, the annuity factors reflect the higher rate of termination in the early years of a claim. Subsequently the annuity values will be increased by the fall in the average level of termination rate but reduced by the fact that the maximum outstanding term of the annuity will fall.

10.5 The overall picture to emerge from these projections is one of a net inflow of monies to the office in the early years of the policy, after the first year strain, and a corresponding outgo in the later years of the policy. The office is therefore very exposed to the risk of writing business on inadequate premium rates and this being initially hidden by inadequate reserves being established. Using the example in Appendix H if the experience inception rates are 50% greater than assumed in the basic run and the earned rate of interest is 6% then (after the first year) the outgo does not exceed income until the 17th year of the policy. As will be realized the faster an office expands its PHI portfolio the longer it will take for an underpricing/under-reserving problem to emerge and the greater will be the cost of rectifying the position. Such a situation could arise because an office does not identify an adverse trend at an early stage and we suggest that the annuity/

inception approach is far less likely than the Manchester Unity approach to generate the misleading statistics that can cause this.

11. TAXATION OF THE POLICYHOLDER

11.1 *Traditional Individual Contracts*

No tax relief is allowed on premiums paid under individual contracts. Benefits are taxed as income but by concession no tax is payable until benefit has been paid for a complete fiscal year (this concession is sometimes referred to as the 'tax holiday'). An individual whose claim commences just after the start of the fiscal year could therefore receive benefits on a tax free basis for up to almost 2 years. In considering the maximum level of cover relative to the policyholder's income the office needs to bear in mind the effect of the tax holiday on the incentive (or disincentive!) for a claimant to resume work.

11.2 *Unit Linked Individual Contracts*

The taxation treatment of premiums and disability benefits is as for the traditional contract. As discussed in § 5 the taxation treatment of the investment income of the unit funds is uncertain and probably depends upon the precise design of the contract. In the case of the contract being taxed along the lines of a life policy it would seem that a tax liability for higher rate taxpayers would arise on the payment of surplus unit funds to the policyholder at the end of the term.

11.3 *Group Contracts*

If premiums are paid by an employer for employees then they are treated as a business expense and are therefore eligible for tax relief. In this case benefits which are payable to the employer to pass to the employee are in effect not taxed in the hands of the employer but taxed in the hands of the employee as salary. The 'tax holiday' does not apply. Where a scheme is established with contributions being paid by the employees premiums and benefits are subject to the same rules as individual policies.

12. OCCUPATIONAL LOADINGS

12.1 It has often been observed that PHI claims experience depends as much upon the attitude of the insured as on objective physical ailments, and clearly some occupations inspire a greater degree of commitment, and eagerness to return to work, than others. Appendix I taken from the General Household Survey 1981 shows the proportions of various occupational groupings absent from work in the previous week due to illness or injury. The worst group, unskilled manual workers, had three and a half times the absentee rate of the best groups.

12.2 The overall volume of U.K. statistics for PHI is limited, and there is even less available to the actuary when it comes to determining whether extra

premiums should be charged for different occupations, and if so how much. It is common to group all occupations into perhaps 3, 4 or 5 classes, ranging from the least hazardous (professional, managerial etc) to the most hazardous, and to charge the same premiums for occupations within one group. There are some occupations which are considered uninsurable. In the past there has not been a great amount of business written for other than Class 1 occupations, but there seems to be an increasing trend to sell PHI outside this occupational group, and if the PHI market is to expand significantly then this trend is likely to continue.

12.3 In the U.K. there is a wide variation between offices' treatment of occupational loadings, and to which classes occupations are allocated. Class 2 occupations might typically attract loadings of between 0% and 25%, depending on deferred period, Class 3 between 15–30% and Class 4 perhaps as much as 100%. It is quite common for the amount of loading to be reduced or eliminated for the longer deferred periods, i.e. deferred 26 or 52 weeks.

12.4 Appendix J shows figures taken from CMI Report Number 7. The number of claim inceptions on which this is based is small, and so the figures may not be very significant. It must be borne in mind that this is a comparison between policies with an extra premium or rating, and those without. It is not a comparison of other classes of occupation with Class 1, as the other classes may not be rated, particularly for the longer deferred periods. Appendix K sets out the claims incidence rates produced by the Society of Actuaries' Committee, and shows the difference between 4 classes of occupation for a 3-month deferred period. The relationship between occupations was derived from the 1976 New York Study.[12] The difference between classes is very large, and would give rise to Class 2 premium rates of at least double Class 1, and up to 6 times for Class 4.

12.5 Although the New York study may well not be entirely appropriate to the U.K.—particularly as much of the U.S.A. business has a limited benefit period of 1 or 2 years—it does seem possible that the loadings currently charged in the U.K. for other than Class 1 occupations are inadequate, and perhaps substantially so. This aspect needs to be considered carefully by any company considering selling PHI to a broader market.

13. SOLVENCY MARGIN

13.1 The required solvency margin for Long-Term Class IV (i.e. PHI) business is 4% of mathematical reserves (adjusted as necessary for reassurance). There is no calculation based on the total sum at risk. This means that the solvency margin is greatest when the reserve is at its maximum, and this may occur during the later stages of the policy term for annual premium business, whereas the maximum potential loss occurs at the start. When compared with other types of risk business it appears illogical not to at least in part match the incidence and size of the solvency margin to the size of the potential claims.

13.2 For example, the 3 per mille solvency margin for Term Assurances (of 5 years or more) imposes a much greater burden, even though PHI business is

subject to greater variability, and therefore arguably riskier, than term business. The solvency margin also appears small when compared with short-term sickness and accident policies, where at least 16–18% of premium income is required. Table 7 illustrates this.

Table 7. *£100 Annual Premium—Male aged 30*

	Typical solvency margin in year 1	Maximum initial loss	
	£	£	%
Level PHI	4	100,000 (discounted value)	·004
Level Term (25 Years)	200	65,000	·308
Short-Term Sickness & Accident	17	6,000	·283

The PHI solvency margin will increase in later years as the reserves build up, but will still be low in comparison with the other types of contract, The minimal capital required to finance PHI solvency margins compared to Life makes it particularly attractive to offices in this respect.

14. OVERINSURANCE

14.1 We saw earlier that U.K. claims experience and premium rates are very favourable when compared with other countries, and there must be a possibility that this situation will change. Simon Courant[6] demonstrated how overall claims experience can deteriorate by as much as 50% in a short period of years, as happened in the U.S.A. and The Netherlands, especially when Social Security benefits become over-generous, and insurers have difficulty in adjusting and reacting. Particularly important is the replacement ratio—the ratio of post- to pre-disability income. Appendix L shows for U.S.A. Group business how the claims experience deteriorates as the replacement ratio increases. Other evidence has shown that the rate of deterioration accelerates dramatically as the replacement ratio approaches and exceeds 100%; and Appendices M and N, taken from Dr Courant's paper, illustrate this.

14.2 In the U.K. it is common in both the Individual and Group markets to allow coverage up to 75% of salary less a deduction for State Invalidity Benefit (with a lower percentage applying for high salaries). Although this would appear to limit the replacement ratio, the insured with maximum cover may suffer very little loss of income following disability, and his net income can in fact be greater than it was prior to claim. In PHI review 1986/87,[5] Mr F. W. G. Martin demonstrates that a married man aged 45 earning £250 per week, with 2 children and with an Individual PHI policy for the above maximum coverage, will in fact receive post-disability net income equal to 114% of his pre-disability net income (and actually even more, 123% during the 'tax holiday' that will apply for the first year or two). These figures and other examples from the same source are

summarized in Appendix O. The situation for Group business can be even worse, as the maximum allowable coverage can be higher. This is because normally only the basic Invalidity Pension (and not Invalidity Allowance or the Earnings Related Supplement) is taken into account, and also the cover can allow for Pension and National Insurance Contributions. However, no 'tax holiday' applies for Group business.

14.3 The main reasons why this overinsurance develops from an apparently conservative formula (75% of salary less Single Person's State Invalidity Benefit or basic Invalidity Benefit for Group business) are:

(1) The formula ignores the other State Invalidity Benefits—Adult Dependants Allowance, Child Dependants Allowance, and also Invalidity Allowance and the Earnings Related Supplement for Group business.
(2) All State Invalidity Benefits are tax free.

14.4 The situation is unsatisfactory and undoubtedly results in insurers experiencing worse claims experience than otherwise would apply. Possible solutions would be to fully integrate the PHI benefit with all State Invalidity Benefits, and/or to reduce the allowable proportion of salary from 75%. However, insurers seem unwilling to act in isolation, and the market currently shows no signs of a significant change in this area, particularly as regards the 75% figure.

14.5 There have been some instances of multiple claims with several insurers where total claims were well in excess of previous income, but this could not be detected by any individual insurer. Proposals have been put to the LIC that a Registry of PHI claims be kept, perhaps during the first 2 or 3 years of claim, so that this situation can be detected.

15. CONCLUSION

"My long sickness of health and living now begins to mend, and nothing brings me all things."

William Shakespeare, *Timon of Athens*

In this paper we have tried to cover the principal features of PHI in the U.K., and to comment on areas which seem significant or problematic to us. Any opinions expressed are attributable solely to us, and do not necessarily reflect the views of our firm. We would like to record thanks to those who provided comments and advice, and to Judith Aspinall for cheerfully typing it up.

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APPENDIX A

RATIOS OF FEMALE CLAIM COSTS TO MALE CLAIM COSTS BY OCCUPATION AND AGE

Occupation class	Attained age				
	20–29	30–39	40–49	50–59	60–69
Total—All Classes	1·43	2·22	1·90	1·31	·98
Class I (Professional, White Collar etc)	1·44	2·41	1·82	1·28	·90
Class II (Tradesmen, Foremen etc)	1·45	2·08	1·84	1·30	1·18
Class III (Skilled Craftsmen etc)	1·40	1·99	2·24	1·49	1·06
Class IV (Heavy Labourers, Miners etc)*	1·28	·20	1·16	·64	1·24

* Data not regarded as credible because of insufficient volume.
Source: State of New York Insurance Department—Disability Income Insurance Cost Differentials Between Men and Women (1976).

APPENDIX B

PREMIUM COMPARISON
DISABILITY INCOME POLICY TO AGE 65
ISSUE AGE 35, DEFERMENT 6 MONTHS

	Non-can or adjustable premium	Total or partial	Premium per 1,000 annual benefit
United Kingdom	NC	T	16
Australia	NC	T	21
United States of America	NC	T	22
Denmark	NC	P	27
Belgium	A	P	32
Switzerland	NC	P	40
Norway	A	P	60
Germany	A	P	87*
Netherlands	A	P	152

* No deferment if disability is permanent.
Definition varies from 'own occ'. To 'own or similar occ'.
Rates shown would be offered to best occupations only in U.K., Australia and U.S.A. to white collar workers in Germany and Denmark and to almost all persons with insurable interest in the other countries.

APPENDIX C

CMI INDIVIDUAL AGGREGATE MALE EXPERIENCE

Claim inception rates per 10,000

Age:	40–44	45–49	50–54	55–59	60–64	All ages
Deferred 4 weeks						
1972–75	260	290	300	380	490	220
1975–78	228	265	340	411	655	231
1979–82*	176	217	241	332	421	192
Deferred 13 weeks						
1972–75	40	60	70	130	210	50
1975–78	44	55	71	114	183	47
1979–82*	33	43	69	104	160	42
Deferred 26 weeks						
1972–75	10	20	30	50	90	10
1975–78	10	17	32	57	95	17
1979–82*	9	12	23	55	89	16

* Average of the 1979–82 rates.

APPENDIX D

DISABILITY TABLE STUDY
DETERMINING VARIABLES

Claim termination rates

Termination rate data was analysed as to the significance by duration of each of 12 reported variables. The variables found to be significant and the durations for which they are significant are shown. (Note that the period of observation provided too little data to determine the significance of the 'his own occ' clause.)

Determining variables		By week 0-13	4-6	By month 7-12	13-24	By year 3-10	By attained age over 10 years
Age		....	....	....	....	....	....
Sex	Male	....	....	....	....	....	....
	Female	....	....	....	....	....	....
Cause	Accident	....	....	.... } Independent			
	Sickness	....	....	.... }			
Deferred period	0 Day	.... } Combined					
	7 Day	.... }	} Independent				
	14 Day	.... } Combined	}				
	30 Day	.... }	90 Day				
Occupation class	Cl. 1	.... }					
	2	.... } Independent					
	3	.... }					
	4*	.... }					

* Small volume of data.

Rates of termination vary by age, sex, cause, deferred period, occupation, class and for each claim duration as shown by the dotted lines.

APPENDIX E

DTS VALUATION TABLE

Claim inception rates per 1,000 lives exposed

		Male—Accident deferred period						Male—Sickness deferred period			
	Age	0 d	7 d	14 d	30 d	90 d	Age	0 d	7 d	14 d	30 d	90 d
Class 1	25	33·97	25·84	13·13	4·90	·86	25	—	32·26	18·22	5·51	1·01
	35	32·88	24·42	11·99	4·23	·51	35	—	36·11	21·55	6·48	1·13
	45	30·40	20·40	9·86	4·50	·65	45	—	47·12	31·19	12·63	2·70
	55	30·19	18·32	9·63	4·71	·80	55	—	69·48	52·75	25·11	7·78
	62	33·45	16·11	10·39	5·47	1·18	62	—	91·52	74·06	41·24	15·20
Class 2	25	59·96	47·98	30·01	10·48	2·07	25	—	46·61	27·01	12·17	2·23
	35	59·96	44·62	28·83	10·14	2·09	35	—	52·79	33·37	14·47	2·56
	45	56·74	38·49	25·67	9·86	2·14	45	—	65·97	46·91	25·40	6·21
	55	51·66	31·31	20·50	10·03	2·20	55	—	92·99	71·27	41·37	15·74
	62	52·84	29·85	19·86	10·92	2·57	62	—	116·81	93·05	58·54	25·94
Class 3	25	75·80	62·68	42·87	23·69	7·04	25	—	46·83	32·22	14·75	2·99
	35	74·78	58·37	39·59	22·57	6·48	35	—	52·72	38·32	18·70	3·52
	45	69·76	50·41	34·61	20·49	5·97	45	—	67·05	51·53	29·45	7·83
	55	66·37	44·27	30·51	18·49	5·46	55	—	92·60	76·39	52·66	20·07
	62	65·04	39·98	27·96	18·56	5·30	62	—	116·23	98·78	78·56	36·04
Class 4	25	89·42	77·60	52·59	27·03	8·73	25	—	48·20	33·28	15·07	3·04
	35	91·59	73·24	50·53	26·93	8·17	35	—	53·75	39·27	19·33	3·59
	45	84·64	62·13	42·61	24·78	7·68	45	—	70·03	52·71	30·13	7·97
	55	79·77	52·03	37·34	22·78	7·27	55	—	95·01	77·91	55·87	20·45
	62	79·95	49·76	36·11	22·96	7·20	62	—	119·16	101·41	81·62	36·63

APPENDIX E

DTS VALUATION TABLE

Claim inception rates per 1,000 lives exposed

		Female—Accident deferred period						Female—Sickness deferred period			
	Age	0 d	7 d	14 d	30 d	90 d	Age	0 d	7 d	14 d	30 d	90 d
Class 1	25	23·06	19·92	12·96	6·00	1·14	25	—	61·10	39·29	14·03	2·55
	35	26·28	20·87	13·39	6·21	·91	35	—	84·38	56·89	24·75	4·37
	45	32·36	22·77	13·78	6·83	1·11	45	—	94·57	68·33	34·14	7·64
	55	45·05	26·77	14·82	8·06	1·46	55	—	90·28	61·49	34·23	10·31
	62	69·00	31·56	17·54	9·91	2·25	62	—	93·06	69·44	45·30	13·85
Class 2	25	35·05	31·48	23·39	13·40	3·22	25	—	80·97	53·57	20·03	3·75
	35	39·36	32·01	23·36	14·02	3·20	35	—	116·02	80·05	35·34	6·60
	45	47·46	33·55	24·40	15·02	3·40	45	—	134·18	92·93	47·62	10·81
	55	62·53	37·10	26·13	16·11	3·75	55	—	117·29	84·93	49·00	14·95
	62	88·91	44·31	29·27	17·88	4·46	62	—	120·40	87·53	63·15	18·86
Class 3	25	41·93	38·01	27·94	17·63	6·19	25	—	86·64	57·85	24·83	5·03
	35	46·30	38·45	28·54	18·20	6·54	35	—	124·79	96·77	44·67	8·43
	45	53·01	39·08	29·09	19·24	6·75	45	—	145·58	116·19	58·44	14·43
	55	66·71	41·96	30·86	20·99	7·08	55	—	122·98	99·89	59·99	17·86
	62	90·05	48·12	33·60	23·74	7·26	62	—	125·95	101·06	69·18	22·76
Class 4	25	52·41	47·52	34·93	22·04	7·74	25	—	90·24	60·26	25·86	5·23
	35	57·87	48·07	35·67	22·75	8·17	35	—	130·00	100·81	46·53	8·79
	45	66·26	48·86	36·36	24·05	8·45	45	—	151·65	121·04	60·87	15·03
	55	83·39	52·45	38·58	26·25	8·85	55	—	128·10	104·05	62·49	18·61
	62	112·57	60·16	42·00	29·67	9·08	62	—	131·20	105·27	72·07	23·71

APPENDIX E

DTS VALUATION TABLE

Weekly termination rates and factors

	Week 1	Week 2	Week 3
Rate	·132	·114	·111
Age 25	1·019	1·138	1·127
DP 0, 7, 14, 30	1·000	1·053 ·941	1·131 1·066 ·788
Class 1, 2, 3, 4	·978 ·981 ·995 1·011	·951 ·968 1·012 1·053	·963 ·983 1·009 1·036
Sex M, F	1·154 ·859	1·142 ·858	1·101 ·897
Cause A, S	1·034 ·957	·956 1·018	·912 1·074
Age 35	1·014	·961	·959
DP 0, 7, 14, 30	1·000	1·062 ·934	1·176 1·067 ·757
Class 1, 2, 3, 4	1·111 1·030 ·957 ·882	1·046 ·999 ·977 ·960	1·006 ·998 ·995 ·991
Sex M, F	·901	1·190 ·824	1·146 ·862
Cause A, S	·994	1·044 ·933	·996 ·984
Age 45	1·027	·894	·898
DP 0, 7, 14, 30	1·000	1·082 ·916	1·218 1·053 ·741
Class 1, 2, 3, 4	1·215 1·070 ·934 ·796	1·135 1·029 ·951 ·884	1·061 1·017 ·977 ·939
Sex M, F	1·038 ·955	1·146 ·856	1·110 ·890
Cause A, S	·977 1·013	1·132 ·860	1·090 ·898
Age 55	1·016	·949	·942
DP 0, 7, 14, 30	1·000	1·136 ·873	1·263 1·001 ·751
Class 1, 2, 3, 4	1·243 1·080 ·936 ·769	1·193 1·057 ·935 ·832	1·120 1·039 ·959 ·887
Sex M, F	·972 ·960	1·002 ·978	1·000 ·988
Cause A, S	1·031	1·191 ·817	1·171 ·836
Age 62	·924	1·058	1·072
DP 0, 7, 14, 30	1·000	1·109 ·894	1·210 ·958 ·819
Class 1, 2, 3, 4	1·205 1·072 ·938 ·797	1·185 1·066 ·941 ·825	1·167 1·057 ·949 ·847
Sex M, F	·908 1·092	·850 1·153	·873 1·132
Cause A, S	1·245 ·794	1·300 ·749	1·266 ·773

The termination rate is the product of the duration rate and the corresponding variable factors.
i.e., for week 2 (·114), age 35 (·961), DP 7 day (·934), class 2 (·999), male (1·190), accident (1·044), the termination rate is ·127.

APPENDIX E

DTS VALUATION TABLE

Weekly termination rates and factors

	Rate	Week 4	Week 5	Week 6
Rate	·119		·112*	·117
Age 25	1·105		1·048	1·060
DP 0, 7, 14, 30	1·061	1·074 ·849	1·156 1·246 1·036 ·597	1·076 1·210 1·048 ·689
Class 1, 2, 3, 4	·983	·997 1·005	1·006 1·006 1·000 ·984	·992 1·008 1·007 ·990
Sex M, F	1·079	·922	1·060 ·942	1·036 ·965
Cause A, S	·894	1·098 1·009	·884 1·112	·878 1·118
Age 35	·997		·985	1·019
DP 0, 7, 14, 30	1·130	1·049 ·815	1·249 1·191 ·985 ·608	1·164 1·153 ·998 ·701
Class 1, 2, 3, 4	1·007	1·001 ·996	1·007 1·003 ·997 ·988	·999 1·003 1·002 ·994
Sex M, F	1·090	·913	1·055 ·946	1·019 ·981
Cause A, S	·960	1·023 ·991	·937 1·050	·925 1·062
Age 45	·943		·962	·988
DP 0, 7, 14, 30	1·185	1·023 ·797	1·298 1·123 ·938 ·652	1·206 1·096 ·962 ·738
Class 1, 2, 3, 4	1·041	1·011 ·984	1·025 1·009 ·990 ·972	1·015 1·006 ·995 ·983
Sex M, F	1·063	·936	1·033 ·966	1·005 ·995
Cause A, S	1·046	·939 ·960	1·014 ·970	1·002 ·981
Age 55	·948		·977	·969
DP 0, 7, 14, 30	1·228	·988 ·797	1·298 1·056 ·897 ·725	1·220 1·052 ·930 ·786
Class 1, 2, 3, 4	1·086	1·028 ·970	1·060 1·023 ·979 ·938	1·041 1·018 ·985 ·956
Sex M, F	1·000	·995	·997 1·001	·995 1·005
Cause A, S	1·142	·860 ·918	1·118 ·879	1·111 ·884
Age 62	1·007		1·028	·965
DP 0, 7, 14, 30	1·210	·965 ·827	1·257 1·004 ·867 ·815	1·196 1·031 ·896 ·849
Class 1, 2, 3, 4	1·143	1·049 ·955	1·120 1·044 ·962 ·885	1·090 1·040 ·971 ·906
Sex M, F	·922	1·080	·955 1·045	·988 1·012
Cause A, S	1·257	·781 ·868	1·245 ·790	1·260 ·780

* Use ·080 for 30-day Deferred Period to allow for the short week from 30 to 35 days.

APPENDIX E

DTS VALUATION TABLE

Weekly termination rates and factors

Rate	Week 7				Week 8				Week 9			
	·120				·119				·116			
Age 25	1·066				1·073				1·079			
DP 0, 7, 14, 30	1·018	1·177	1·053	·760	·980	1·147	1·054	·820	·958	1·118	1·049	·873
Class 1, 2, 3, 4	·986	1·010	1·009	·993	·983	1·009	1·010	·997	·978	1·007	1·012	1·004
Sex M, F	1·022	·978			1·012	·988			1·004	·995		
Cause A, S	·874	1·125			·871	1·129			·870	1·131		
Age 35	1·043				1·058				1·066			
DP 0, 7, 14, 30	1·119	1·121	1·006	·759	1·082	1·099	1·013	·807	1·051	1·082	1·017	·848
Class 1, 2, 3, 4	·996	1·001	1·003	·998	·993	1·000	1·004	1·003	·990	·999	1·005	1·006
Sex M, F	·994	1·005			·978	1·022			·967	1·033		
Cause A, S	·916	1·073			·912	1·078			·913	1·078		
Age 45	1·007				1·019				1·024			
DP 0, 7, 14, 30	1·172	1·073	·974	·783	1·143	1·057	·983	·818	1·113	1·046	·990	·851
Class 1, 2, 3, 4	1·010	1·003	·996	·990	1·006	1·000	·997	·995	1·004	·999	·998	·998
Sex M, F	·984	1·016			·969	1·031			·959	1·042		
Cause A, S	·989	·994			·982	1·001			·981	1·003		
Age 55	·964				·961				·957			
DP 0, 7, 14, 30	1·196	1·041	·946	·814	1·171	1·031	·957	·841	1·147	1·021	·964	·869
Class 1, 2, 3, 4	1·030	1·013	·989	·968	1·023	1·009	·991	·976	1·020	1·007	·993	·981
Sex M, F	·990	1·010			·984	1·016			·976	1·024		
Cause A, S	1·098	·895			1·089	·902			1·084	·908		
Age 62	·920				·890				·874			
DP 0, 7, 14, 30	1·191	1·031	·910	·857	1·180	1·024	·917	·876	1·166	1·010	·919	·907
Class 1, 2, 3, 4	1·071	1·037	·977	·921	1·058	1·033	·980	·933	1·048	1·028	·982	·944
Sex M, F	1·011	·988			1·025	·975			1·024	·976		
Cause A, S	1·253	·785			1·245	·790			1·236	·796		

APPENDIX E

DTS VALUATION TABLE

Weekly termination rates and factors

Rate	Week 10				Week 11				Week 12			
Rate	·111				·104				·094			
Age 25	1·086				1·096				1·110			
DP 0, 7, 14, 30	·951	1·087	1·038	·921	·963	1·051	1·018	·964	·996	1·008	·985	1·007
Class 1, 2, 3, 4	·972	1·002	1·013	1·013	·966	·994	1·015	1·026	·957	·982	1·017	1·045
Sex M, F	·997	1·002			·990	1·008			·984	1·013		
Cause A, S	·871	1·131			·876	1·127			·884	1·118		
Age 35	1·068				1·062				1·049			
DP 0, 7, 14, 30	1·025	1·069	1·019	·885	1·003	1·058	1·017	·920	·985	1·049	1·008	·955
Class 1, 2, 3, 4	·986	·997	1·006	1·010	·981	·996	1·007	1·015	·974	·994	1·009	1·002
Sex M, F	·961	1·040			·958	1·042			·959	1·039		
Cause A, S	·919	1·072			·930	1·060			·950	1·040		
Age 45	1·022				1·012				·993			
DP 0, 7, 14, 30	1·083	1·040	·995	·882	1·048	1·039	·998	·914	1·007	1·043	·997	·951
Class 1, 2, 3, 4	1·002	·999	·999	1·000	1·001	1·000	1·000	·999	1·000	1·003	1·000	·995
Sex M, F	·951	1·050			·946	1·055			·943	1·057		
Cause A, S	·986	·999			·998	·989			1·020	·969		
Age 55	·953				·948				·941			
DP 0, 7, 14, 30	1·121	1·013	·967	·900	1·090	1·005	·966	·938	1·052	·997	·959	·989
Class 1, 2, 3, 4	1·019	1·005	·993	·982	1·022	1·006	·992	·980	1·031	1·009	·989	·971
Sex M, F	·966	1·034			·953	1·048			·935	1·066		
Cause A, S	1·082	·910			1·086	·909			1·094	·904		
Age 62	·871				·881				·907			
DP 0, 7, 14, 30	1·147	·987	·917	·951	1·119	·956	·913	1·017	1·079	·914	·906	1·114
Class 1, 2, 3, 4	1·043	1·022	·984	·953	1·041	1·016	·984	·961	1·043	1·009	·982	·967
Sex M, F	1·008	·991			·975	1·024			·920	1·083		
Cause A, S	1·223	·806			1·210	·816			1·193	·829		

APPENDIX E

DTS VALUATION TABLE
Weekly termination rates and factors

Week 13

Rate	·082			
Age 25	1·133			
DP 0, 7, 14, 30	1·059	·949	·935	1·050
Class 1, 2, 3, 4	·944	·964	1·021	1·074
Sex M, F	·975	1·018		
Cause A, S	·897	1·104		
Age 35	1·027			
DP 0, 7, 14, 30	·971	1·038	·989	·992
Class 1, 2, 3, 4	·962	·993	1·012	1·032
Sex M, F	·967	1·026		
Cause A, S	·984	1·006		
Age 45	·962			
DP 0, 7, 14, 30	·952	1·054	·989	·995
Class 1, 2, 3, 4	1·000	1·008	1·001	·989
Sex M, F	·942	1·053		
Cause A, S	1·058	·935		
Age 55	·932			
DP 0, 7, 14, 30	·999	·988	·943	1·062
Class 1, 2, 3, 4	1·048	1·015	·984	·953
Sex M, F	·908	1·092		
Cause A, S	1·110	·891		
Age 62	·946			
DP 0, 7, 14, 30	1·024	·853	·894	1·265
Class 1, 2, 3, 4	1·052	·998	·978	·972
Sex M, F	·844	1·175		
Cause A, S	1·166	·849		

APPENDIX E

DTS VALUATION TABLE

Monthly termination rates and factors

	Month 4		Month 5		Month 6	
Rate:	·224		·198		·173	
< 90d DP	1·172		1·109		1·051	
90d DP	·828		·891		·949	
Male:	·989		·981		·975	
Female:	1·011		1·019		1·025	
Age 25 A, S	1·082	1·186	1·103	1·182	1·149	1·173
Age 35 A, S	1·039	1·103	1·065	1·123	1·089	1·134
Age 45 A, S	1·012	·989	1·045	·993	1·061	·989
Age 55 A, S	1·017	·857	·980	·837	·970	·809
Age 62 A, S	·981	·732	·971	·701	·963	·663

	Month 7		Month 8		Month 9	
Rate:	·145		·118		·090	
Male:	·947		·943		·939	
Female:	1·053		1·057		1·061	
Age 25 A, S	1·204	1·218	1·259	1·262	1·351	1·289
Age 35 A, S	1·108	1·187	1·127	1·240	1·167	1·243
Age 45 A, S	1·040	1·019	1·019	1·048	1·031	1·021
Age 55 A, S	·920	·815	·869	·820	·856	·772
Age 62 A, S	·835	·657	·706	·651	·671	·600

	Month 10		Month 11		Month 12	
Rate:	·071		·063		·057	
Male:	·935		·931		·945	
Female:	1·065		1·069		1·055	
Age 25 A, S	1·442	1·317	1·534	1·344	1·626	1·371
Age 35 A, S	1·207	1·245	1·247	1·248	1·287	1·251
Age 45 A, S	1·042	·993	1·054	·966	1·066	·939
Age 55 A, S	·844	·724	·831	·676	·818	·628
Age 62 A, S	·637	·550	·602	·499	·567	·448

APPENDIX E

DTS VALUATION TABLE

Monthly termination rates and factors:
2nd year of disablement

Month	13	14	15	16	17	18
Rate:	·051	·046	·042	·037	·031	·028
Male:	·960	·975	·978	·981	·984	·988
Female:	1·040	1·025	1·022	1·019	1·016	1·012
Age 25	1·558	1·625	1·692	1·758	1·825	1·897
Age 35	1·288	1·292	1·296	1·299	1·303	1·298
Age 45	·971	·937	·903	·869	·835	·797
Age 55	·658	·629	·600	·571	·542	·516
Age 62	·524	·517	·510	·503	·496	·493

Month	19	20	21	22	23	24
Rate:	·024	·021	·019	·017	·016	·015
Male:	·993	·997	1·001	1·005	1·009	1·013
Female:	1·007	1·003	·999	·995	·991	·987
Age 25	1·970	2·042	2·061	2·079	2·098	2·117
Age 35	1·294	1·289	1·265	1·241	1·217	1·193
Age 45	·758	·720	·706	·693	·679	·665
Age 55	·489	·463	·471	·479	·487	·495
Age 62	·489	·486	·497	·508	·519	·530

APPENDIX E

DTS VALUATION TABLE

Annual termination rates:
Years 3 through 10

Year	3	4	5	6
Rate:	·123	·084	·062	·050
Male:	1·080	1·129	1·179	1·200
Female:	·920	·871	·821	·800
Age 25	2·085	1·832	1·554	1·262
Age 35	1·164	1·103	1·017	·909
Age 45	·727	·757	·767	·754
Age 55	·536	·616	·697	·832
Age 62	·489	·691	·965	1·244

Year	7	8	9	10
Rate:	·045	·042	·042	·043
Male:	1·212	1·210	1·204	1·200
Female:	·788	·790	·796	·800
Age 25	·994	·776	·617	·524
Age 35	·792	·696	·631	·582
Age 45	·741	·737	·739	·751
Age 55	·984	1·103	1·182	1·226
Age 62	1·489	1·688	1·830	1·918

APPENDIX E

5-POINT LAGRANGE INTERPOLATION FORMULA

Used for incidence rates and termination rates.
Given points $F(a)$, $F(b)$, $F(c)$, $F(d)$, and $F(e)$, then:

$$F(x) = \frac{(x-b)}{(a-b)} \frac{(x-c)}{(a-c)} \frac{(x-d)}{(a-d)} \frac{(x-e)}{(a-e)} \; F(a)$$

$$+ \frac{(x-a)}{(b-a)} \frac{(x-c)}{(b-c)} \frac{(x-d)}{(b-d)} \frac{(x-e)}{(b-e)} \; F(b)$$

$$\cdot$$
$$\cdot$$
$$\cdot$$

$$+ \frac{(x-a)}{(e-a)} \frac{(x-b)}{(e-b)} \frac{(x-c)}{(e-c)} \frac{(x-d)}{(e-d)} \; F(e)$$

for $a < x < e$,
a, b, c, d, e are ages 25, 35, 45, 55, and 62 respectively.
When $x \leq 25$:
for incidence rates, $F(x) = F(25)$
for termination rates, $F(x) = F(25) + (25 - x) [F(25) - F(26)]$
When $x \geq 62$:
$F(x) = F(62) + (x - 62) [F(62) - F(61)]$

APPENDIX E

DTS VALUATION TABLE

Ultimate termination rates: Duration 11 years and over by attained age

Attained age	Male	Female	Attained age	Male	Female
30	·0238	·0160	65	·0665	·0446
31	·0240	·0161	66	·0707	·0474
32	·0242	·0162	67	·0753	·0504
33	·0244	·0163	68	·0802	·0538
34	·0246	·0165	69	·0857	·0574
35	·0249	·0167	70	·0916	·0614
36	·0251	·0168	71	·0986	·0657
37	·0254	·0170	72	·1051	·0704
38	·0258	·0173	73	·1127	·0755
39	·0261	·0175	74	·1210	·0811
40	·0265	·0178	75	·1301	·0871
41	·0270	·0181	76	·1398	·0937
42	·0275	·0184	77	·1504	·1008
43	·0280	·0188	78	·1619	·1085
44	·0286	·0192	79	·1743	·1168
45	·0292	·0196	80	·1878	·1258
46	·0299	·0200	81	·2022	·1355
47	·0306	·0205	82	·2178	·1459
48	·0315	·0211	83	·2345	·1571
49	·0324	·0217	84	·2525	·1691
50	·0334	·0224	85	·2717	·1820
51	·0345	·0231	86	·2922	·1958
52	·0357	·0239	87	·3140	·2104
53	·0370	·0248	88	·3372	·2259
54	·0384	·0257	89	·3618	·2424
55	·0400	·0268	90	·3877	·2598
56	·0417	·0279	91	·4149	·2780
57	·0436	·0292	92	·4435	·2971
58	·0456	·0306	93	·4732	·3171
59	·0479	·0321	94	·5041	·3378
60	·0503	·0337	95	·5360	·3591
61	·0530	·0355	96	·5686	·3801
62	·0559	·0375	97	·6020	·4033
63	·0592	·0397	98	·6357	·4259
64	·0627	·0420	99	·6695	·4486

APPENDIX E

CLAIM RESERVES—DISABILITY ANNUITY OF £1 P.A. EXPIRING ON DEATH, RECOVERY OR 65

Duration since disability	Age at disability	Deferred 1 month			Deferred 6 months		
		35	45	55	35	45	55
1 month		0·764	0·983	1·036	—	—	—
6 months		3·094	3·785	3·420	3·082	3·789	3·427
1 year		5·450	6·100	4·724	5·450	6·100	4·724
2 years		7·804	7·492	4·964	7·804	7·492	4·964
5 years		9·415	7·615	3·532	9·415	7·615	3·532
10 years		8·999	6·038	—	8·999	6·038	—
20 years		6·038	—	—	6·038	—	—

Basis: DTS valuation table, males, occupation class 1, 6% interest, with monthly payments.

APPENDIX F

DISABILITY TERMINATION RATES PER 1,000

Age (x)	Cause*	DTS Ultimate Rate (Males) 11+ (1)	Ordinary Waiver '69-'74 11+ (2)	OASDI '73-'76 6+ (3)	OASDI '75-'78 6+ (4)	OASDI '73-'77 11+ (5)	Group Waiver '55-'64 (6)	Ben. 2&3 $(x+\frac{1}{2})$ '30-'50 (7)	Mutual of Omaha '70-'77 (8)
Duration (Years)									
22	D	8·9						N	
	R	14·0						N	
	T	22·9						N	N
27	D	9·8	N	9·9	9·7		16	N	
	R	13·6	N	34·0	33·9		20	N	
	T	23·4	N	43·9	43·6		36	N	N
32	D	11·2	19·7	12·6	12·7		17	12·6	
	R	12·9	19·7	19·6	20·4		19	52·8	
	T	24·1	39·4	32·2	33·1	63·1	36	65·4	N
37	D	13·2	13·6	16·0	15·9		18	15·5	
	R	12·2	6·8	11·3	12·4		18	46·3	
	T	25·4	20·4	27·3	28·3	21·3	36	61·8	40
42	D	16·3	12·8	21·9	21·0		26	19·1	
	R	11·2	12·8	8·0	8·8		16	39·8	
	T	27·5	25·6	29·9	29·8	25·1	42	58·9	49
47	D	20·9	18·1	28·8	27·9		33	22·2	
	R	9·7	9·8	5·4	6·3		14	33·3	
	T	30·6	27·9	34·2	34·2	29·9	47	55·5	42
52	D	27·8	37·7	39·0	37·6		39	25·8	
	R	7·8	6·6	3·1	3·7		12	26·8	
	T	35·6	44·3	42·1	41·3	38·5	51	52·6	64
57	D	37·9	37·1	51·6	48·1		46	33·4	
	R	5·7	4·6	1·6	1·9		7	20·2	
	T	43·6	41·7	53·2	50·0	49·5	53	53·6	64
62	D	52·9	67·2	54·2	60·8		58	47·7	
	R	3·0	3·7	1·4	·8		5	13·7	
	T	55·9	70·9	55·6	61·6	61·7	63	61·4	52

* D = death; R = recovery; T = death & recovery.
(1) Based on graduation formulae.
(2) Data provided by Mr John H. Cook, FSA from contributions to the intercompany Disability Waiver of Premium study.
(3) Actuarial Study No. 75 (Social Security).
(4) Actuarial Study No. 81 (Social Security).
(5) Data supplied by Mr Francisco R. Bayo for ultimate experience after first 10 years of disablement.
(6) TSA 1968 Reports, page 194.
(7) TSA 1952 Reports, page 106.
(8) Derived from recent termination study by Mutual of Omaha.

APPENDIX G

COMPARISON OF DTS CLAIM INCIDENCE RATES WITH CMI 7

Rates per 1000 lives exposed—Males

Age Attained	Deferred 1 week			Deferred 4 weeks			Deferred 13 weeks		
	DTS	CMI	(%)	DTS	CMI	(%)	DTS	CMI	(%)
25	58·10	115·2	50·4	10·41	7·2	144·6	1·87	1·0	187·0
35	60·53	125·5	48·2	10·71	14·0	76·5	1·64	2·5	65·6
45	67·52	128·4	52·6	17·13	20·4	84·0	3·35	4·4	76·1
55	87·80	142·5	61·6	29·82	33·4	89·3	8·58	8·7	98·6
62	107·63	173·8	61·9	46·71	63·3	73·8	16·38	18·2	90·0

Notes
1. DTS Occupation Class 1.
2. CMI standard graduated inception rates.

APPENDIX H

PROFIT TEST BASED ON 100 POLICIES

The assumptions are as follows:

Policy:

Age at entry	40 years
Term	25 years
Deferred period	6 months
Benefit p.a.	£10,000
Annual Premium	£190

Experience:

Interest earned	7·5%
Morbidity	Based on CMI 7 inception rates and adjusted DTS termination rates for a male life
Mortality	80% of A67/70 Ultimate with an allowance for selection
Expenses and commission	Initial 75% of the office premium plus £107·50 per policy Renewal £10 p.a. initially increasing by 5% p.a. plus 2·5% of premiums plus 2·5% of benefits payable
Lapse rates	10% year 1, 7·5% year 2, 5% thereafter

Valuation Basis (gross premium basis)

Interest	6% p.a.
Morbidity	Based on CMI 7 inception rates loaded by 20% and adjusted DTS termination rates 80% of A67/70 Ultimate with an allowance for selection
Expense loading	25% of office premium

APPENDIX H

RESULT

Year	Active life reserve (start of year)	Claims reserve (end of year)	Premiums	Benefits paid	Expenses	Investment income	Gross cash flow
1	4,644	2,272	19,000	86	25,002	(105)	(13,109)
2	15,332	6,649	17,086	649	1,342	2,477	2,507
3	21,923	10,865	15,785	1,211	1,297	3,185	5,655
4	28,062	15,055	14,973	1,720	1,286	3,883	5,521
5	33,341	19,249	14,200	2,221	1,276	4,517	5,747
10	47,237	39,613	10,852	5,013	1,240	6,759	6,272
15	41,513	55,794	8,211	8,754	1,239	7,308	5,625
20	19,768	55,548	6,109	14,047	1,277	5.694	4,159
21	14,723	50,923	5,742	15,339	1,291	5,043	3,825
22	9,958	43,793	5,390	16,716	1,306	4,261	3,524
23	5,846	33,510	5,053	18,181	1,322	3,337	3,282
24	2,870	19,273	4,730	19,737	1,339	2,261	3,128
25	1,648	—	4,421	21,386	1,360	1,016	4,834

Present value of Future Profits at commencement = 22,420 = 118% of Annual Premium (discounting gross cash flow at 15%).

APPENDIX I

PERCENTAGES OF EMPLOYEES ABSENT
FROM WORK IN THE PREVIOUS WEEK

Socio-economic group	Percentages absent because of own illness or injury
Managers in large establishments	2
Managers in small establishments	2
Professional workers—employees	3
Intermediate non-manual workers	3
Junior non-manual workers	4
Personal service workers	5
Foreman and supervisors	3
Skilled manual workers	5
Semi skilled manual workers	6
Unskilled manual workers	7
Farmers—managers } Agricultural workers }	5
Total	4

Source: General Household Survey 1981

APPENDIX J

CMI 7—COMPARISON OF POLICIES RATED FOR OCCUPATION WITH STANDARD EXPERIENCE

Number of claim inceptions—Actual/Expected

Age group	Deferred 4 weeks (%)	Deferred 13 weeks (%)	Deferred* 26 weeks (%)
Under 40	195	223	191
40–49	165	171	57
50–59	171	174	103
60–64	107	250	—
All ages	181	199	104
Expected inceptions (all ages)	794	77	18

* Very small numbers of inceptions

APPENDIX K

DTS VALUATION TABLE

Deferred 3 months—Males

Age n.b.d.	Claims incidence rates per 1000	% of Class 1
Occupational Class 1		
(Professional White Collar, etc)		
25	1·87	100
35	1·64	100
45	3·35	100
55	8·58	100
62	16·38	100
Occupational Class 2		
(Tradesmen, Foremen, etc)		
25	4·30	230
35	4·65	284
45	8·35	249
55	17·94	209
62	28·51	174
Occupational Class 3		
(Skilled Craftsmen, etc)		
25	10·03	536
35	10·00	610
45	13·80	412
55	25·53	298
62	41·34	252
Occupational Class 4		
(Heavy labourers, Miners, etc)		
25	11·77	629
35	11·76	717
45	15·65	467
55	27·72	323
62	43·83	268

APPENDIX L

U.S.A. GROUP LONG-TERM DISABILITY INSURANCE EXPERIENCE 1976–80

Six-month Deferred Period, all ages, males and females

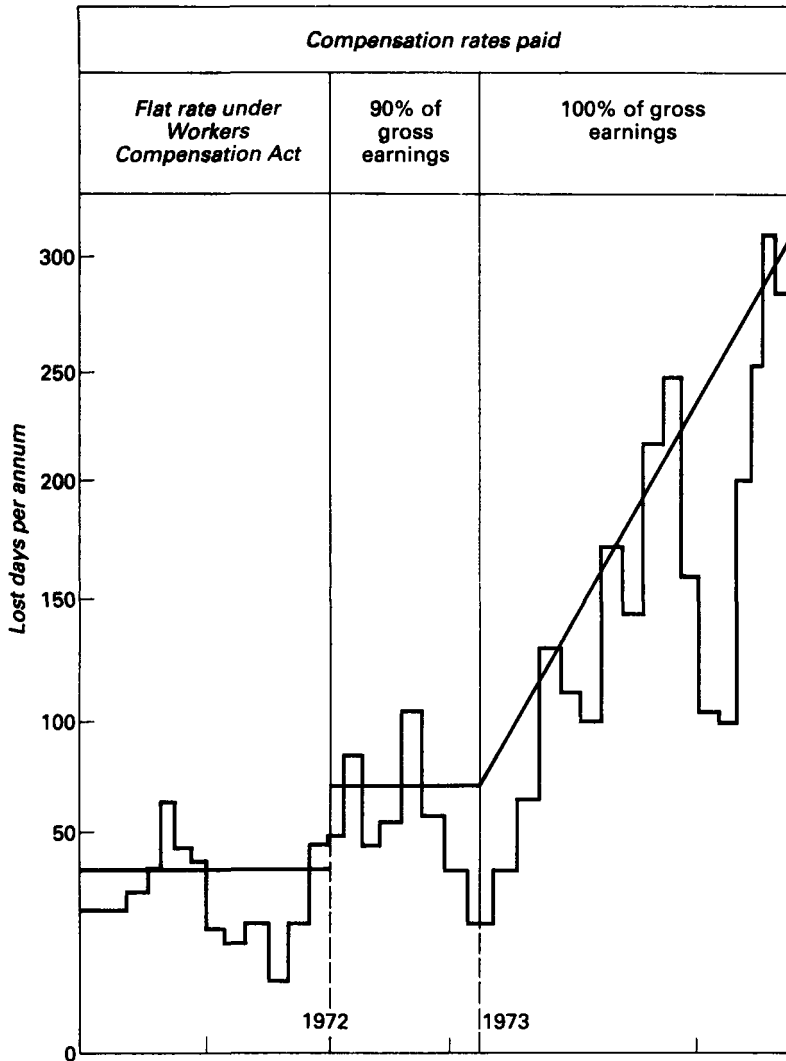| Ratio of gross benefit (before reduction of integration) to salary (%)	Actual/Expected claims (%)
< 50	68
50	76
51–60	91
61–70	106
70–	71*

* There was only a small exposure in this category, and only 8 claims.

APPENDIX M

PENSION FUND
PERTH PASSENGER TRANSPORT TRUST, WESTERN AUSTRALIA

TIME LOST THROUGH WORK CAUSED INJURIES

APPENDIX N

DAILY INDEMNITY FOR SELF-EMPLOYED
IN GERMANY
DEFERMENT PERIOD 7 DAYS

	Claim ratios	
Daily indemnity in German marks	*Commerical and transport*	*Industry and handicraft*
10	21·6	36·7
20	41·7	44·1
30	53·5	48·7
40	57·5	59·4
50	56·5	72·4
60	60·3	58·2
70	58·6	87·1
80	96·0	87·1
100	100·9	92·8

APPENDIX O

RATIO OF POST TO PRE-DISABILITY NET INCOME
(REPLACEMENT RATIO)

	(1) %	(2) %	(3) %
Individual (after tax holiday)	97	114	93
Individual (during tax holiday)	102	123	113
Group	110	127	103

(1) A single man aged 30 earning £150/week.
(2) A married man aged 45, with 2 children and earning £250/week.
(3) A married man aged 55 earning £500/week.

Assumptions
1. Cover limited to 75% of pre-disability income, less an allowance for Invalidity Benefit. For Individual policies only the Invalidity Benefit payable to a single person is taken into account, whereas for Group policies only the basic Invalidity Benefit is taken into account.
2. 5% Contributory Pension Scheme.
Figures taken from Permanent Health Insurance Review 1986/87.