GENERAL INSURANCE STUDY GROUP
WORKING PARTY ON SOLVENCY

REPORT TO GISG MEETING
IN BRISTOL: 3-4 NOVEMBER 1983

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1. INTRODUCTION

1.1 The Working Party on Solvency was established in November 1982 with the following terms of reference:

1. To review the lessons to be learnt from the Finnish report on Solvency of Insurers and Equalization Reserves, and to suggest specific investigations which might be carried out in the U.K in order to develop the Finnish work.

2. To consider the extent to which the variability of a company's results should be reflected in the methods and bases used for the valuation of the assets and liabilities (e.g. by taking margins when valuing certain types of asset, or by the use of equalization reserves when valuing liabilities).

1.2 The report which follows is addressed primarily to the second of those terms of reference. It seeks to establish a framework for considerations of solvency, particularly in so far as they concern the security offered in respect of existing business. In so doing, attention is focussed on accounting principles and methods, and the shortcomings of present arrangements for reporting on general business liabilities.

1.3 The report goes on to investigate variability as it affects the assets side of the balance sheet and concludes that a significant level of solvency margin ought to be required of companies to provide against this risk alone, with its magnitude depending on the nature of the asset portfolio held.

1.4 A conceptual framework is drawn up for setting the line of demarcation between technical reserves and solvency margin and a simple practical approach is considered for giving effect to this subdivision. This would have implications for valuation regulations for general business technical reserves, if an appropriate standard of reserving could not be agreed by the industry on a voluntary basis.

1.5 Brief consideration is given to the implications of reinsurance for solvency and to the question of discounting outstanding claims reserves. The report concludes with some pointers to a possible accounting standard embracing concepts of variability which could form the basis for a more satisfactory system of reporting technical reserves from the point of view of demonstrating solvency and suggests what we consider might be a more rational approach to the statutory solvency margins having regard to the nature of the risks and the possible variability of the outturn.

1.6 Whilst acknowledging the essentially unquantifiable nature of some of the risks against which a solvency margin is needed, quantification of the appropriate level of solvency margin to be held in respect of variability of both assets and liabilities may with advantage be approached by way of risk theoretical considerations. The Finnish Report on Solvency[1] offers some valuable insights into a modelling process for tackling this problem. Appendix 1 to this report considers what we can learn from their work and what further elaboration would be necessary to develop these ideas in the U.K context. Appendix 2 looks at some U.K data to see if it exhibits similar characteristics to those produced for the Finnish market.

1.7 The members of the Working Party were Chris Daykin, Russell Devitt, Rafi Khan and Jim McCaughan. This report has been compiled from a number of papers produced by members for meetings of the Working Party.

2. THE NATURE OF SOLVENCY

2.1 A problem of definition.

2.1.1 The natural meaning of solvency is the possession of sufficient assets to meet all liabilities. It is, however, an imprecise concept, since there is usually uncertainty about the value of the assets held and about the amount of the liabilities. In the context of an insurance company, uncertainty about the liabilities is inherent in the nature of the business carried on and a substantial degree of estimation is required, carrying with it the possibility of significant under or over estimation. Many of the assets may have a well-defined value which can be ascribed to them on the basis of quoted market values, but it is unlikely that the whole portfolio of assets could in fact be realized for what is termed its market value, even on the date to which it relates, and the value will, in any case, change from day to day. Furthermore, what is important is whether the assets will prove sufficient to meet the liabilities at the times when those liabilities fall to be met.

2.1.2 Similar problems of definition exist in relation to the solvency of any company, but in the case of companies other than insurance companies the degree of uncertainty about the amount of the liabilities will usually be much less, as will the proportion of assets subject to significant fluctuation in value. Furthermore, the particular problems associated with the solvency of insurers, and the serious consequences for policyholders of any insurance failure, have led Governments to impose solvency requirements on insurance companies which go beyond the normal concept of solvency in establishing a safety margin by which assets must exceed liabilities. This is normally without prejudice to the definition of insolvency, whereby provisions for winding-up the company would be activated. It does, however, enable an orderly system of supervision to be devised.

2.1.3 A further alternative interpretation of solvency is often used in connection with insurance companies, when considering the extent to which the assets exceed the liabilities. Bare solvency is not usually in question, nor is there any problem about satisfying the statutory requirements for margins of solvency. Solvency in this sense is a measure of the ability of the company to remain financially healthy for the foreseeable future,regardless of cycles of profitability, inflation, movements in asset values and continuing growth in the volume of business written.

2.2 The need for solvency margins.

2.2.1 The primary motivation for a system of solvency margins is the desire to protect the consumer, who will often be potentially heavily financially dependent on an insurance company. However, the avoidance of any insolvencies among insurance companies is clearly in the interests of the industry itself. The maintenance of safety margins and of an adequate level of free reserves is not just a question of government regulation, but of sound financial management.

2.2.2 The aim both of the supervisory authority and of company management must be to ensure that a company remains able to meet its liabilities. Management will be looking for rather more than this, since continued profitability will depend on the company being maintained in a healthy rather than simply a marginal financial state. However, in spite of the obvious desire of management to maintain their company in a satisfactory financial position, the financial status of an insurance company can deteriorate very rapidly for a variety of reasons. A statutory solvency margin is thus intended to provide early warning of the approach of a dangerous situation, to enable corrective action to be taken, or, if it is not, to give time for the supervisory authorities to withdraw the authorization of a company to write new business, or intervene in such other ways as may be appropriate, before a state of insolvency is reached.

2.2.3 The size of the solvency margin must, therefore, be such as not to be too easily whittled away before action can be taken and, furthermore, the assets remaining, even when the solvency margin has largely disappeared, must be sufficient to enable the existing liabilities to be run off, once the company has been closed to new business. In other words, the company must still be solvent in the sense of being able to run off the liabilities satisfactorily, even when the solvency margin has disappeared. The uncertainties inherent in the run-off seem to point to the need for significant margins to be taken in assessing the liabilities and perhaps also in placing a value on the assets, regardless of the existence or otherwise of an additional solvency margin.

2.3 How prudent should technical reserves be ?

2.3.1 In life insurance in the U.K responsibility has traditionally been placed on the actuary to ensure that adequate margins are maintained. His role is to set up reserves on prudent assumptions, taking into account the nature of both assets and liabilities, so that there is a very high probability that the existing liabilities can be fully met. Any excess assets, whether in the so-called long term business fund, the separate account maintained for the long term business, or in the other funds of the company, can then be regarded as free assets constituting a solvency margin. Prior to the introduction of a statutory requirement for a long term business solvency margin, the emphasis was on the provision of such margins as were thought necessary within the reserves set up by the actuary, but the supervisory authorities nevertheless always considered a reasonable level of free assets on top of this to be a prerequisite for continuing to write new business.

2.3.2 Whilst appropriate methods and bases for ensuring a prudent level of reserves are the everyday tools of the life office actuary, comparable methodology for general insurance reserving is much less well developed. General insurance companies are expected to assess the amount of their liabilities

"in accordance with generally accepted accounting concepts, bases and policies or other generally accepted methods appropriate for insurance companies."

2.3.3 This effectively allows a substantial degree of latitude, as will be discussed in more detail below. As a result there are significant shortcomings in current general business reporting, since there are, for example, no agreed standards in respect of the extent to which technical reserves should allow for the potential variability of claim numbers and amounts, there are no generally accepted principles regarding the relationship between assets and liabilities or the need to take asset variability into account, and no agreed methods of providing for the expenses of running off the business, in particular the overrun of operating costs at the going concern level should the company be closed to new business.

2.4 The relationship between technical reserves and the solvency margin.

2.4.1 At one extreme the view could be taken that provision should be made in technical reserves for all the factors associated with the run-off of the existing portfolio of risks. The solvency margin would then provide a buffer to enable a company to continue writing business, to cover the risks of expenses getting out of control, unsatisfactory underwriting leading to significant incurred losses, catastrophe accumulations, fraud, mismanagement and other miscellaneous risks. This would satisfy most closely the requirements of the supervisory authorities, reflect the realities of the framework in which the powers to stop companies writing new business have to be exercised and maximise the chance of an orderly run-off once a stop order had been imposed.

2.4.2 At the other end of the spectrum is the view that technical reserves should provide only for the expected value of the claims outcome, and might perhaps even reflect a somewhat

optimistic view in partial recognition of the role which future investment income may be expected to play in financing claims outgo. On this reasoning the solvency margin is available to absorb adverse fluctuations in the claims experience, higher than expected inflation and lower than expected investment income, as well as all the factors described in the previous paragraph.

2.4.3 Some other countries have adopted an expected value approach for basic technical reserves, but have introduced the concept of an equalization reserve, which is intended to cater for fluctuations in the experience, insurance cycles and occasional heavy losses from catastrophes. This should be considered as part of the technical reserves, and represents in effect only a subdivision of the more stringent concept of technical reserves into two distinct components. In countries where an equalization reserve exists (e.g. Germany and Finland) transfers can be made to the reserve out of pre-tax profits, at least until a certain level is reached. The solvency margin is represented by the excess of assets over technical reserves and equalization reserve taken together.

2.4.4 It does not automatically follow that a level of technical reserves thought desirable by the supervisory authority and by company management will satisfy the tax authorities as being appropriate to be set up out of pre-tax profits. However, if the technical reserves were in accordance with an accepted minimum standard of prudence, laid down in regulation or in an accounting standard, it would be more difficult for the tax authorities to refuse to acknowledge the reserves as reasonable.

2.4.5 The supervisor's view is relatively short term. Apart from the time-lags involved in obtaining information about a company's current situation, the supervisor ought in principle to be able to take action relatively quickly once the position is known. His focus of concern, therefore, is on the next year, starting from the balance sheet date of the returns he is

considering. He wants to see adequate technical reserves set up to meet all possible adverse contingencies of the claims run-off and a solvency margin sufficient to withstand the pressures under which it might come during a further year of operation. If the technical reserves appear weak, he would expect to see correspondingly higher cover of the solvency margin requirements.

2.4.6 The EEC solvency margin régime does not allow the supervisor the possibility of stopping a company from writing new business simply because he perceives there to be a risk of insolvency if the company carries on. Intervention is normally permissible only where the company fails to meet certain specific solvency margin requirements, with the most far-reaching powers only becoming available once the guarantee fund is impaired. Thus the solvency margin must be able to withstand the adverse tendencies of continuing to write business for a year, or perhaps 18 months, to allow for the time-lag of reporting. If at the end of that period the company has not had a further injection of capital or taken action to bring the situation under control, the supervisor can intervene.

2.5 The company view

2.5.1 Whilst the solvency margin is clearly of considerable significance for the supervisory authorities in relation to companies operating on slender margins, whose continuing viability is the subject of some doubt, another view of the topic altogether might be taken in relation to major composite offices and quoted companies. In this context solvency is often used as a synonym for financial strength and attention focuses on the extent of the cover for the statutory solvency margin. The concern is with the long term profitability of the company, including its ability to withstand short term crises and substantial periods of underwriting losses, the potential for growth in the business written, and the likelihood of further share capital being required to finance future expansion.

2.5.2 For such companies the statutory solvency margin is of no direct operational significance, except as a benchmark against which to measure financial strength. Their view of "solvency" is essentially a long term one, and must take account of all the factors impinging on the corporate financial strategy. Any inadequacies in the criteria adopted for technical reserves must be compensated by the declared solvency margin. Particular attention also needs to be paid to the adequacy of premium rates to support the business being written and the longer term consequences of market strategy.

2.6 The Finnish study

2.6.1 In discussing solvency, it is important to establish what aspect is to be considered. To examine all aspects would require a book rather than a report. The Finnish study[1] on "The Solvency of Insurers and Equalization Reserves" in fact runs to two volumes and even so covers certain aspects (e.g. assets) very cursorily. However, Professor Pentikäinen and his team were concerned with the much wider subject of continuing solvency, akin to the financial strength concept discussed above, rather than the one-year horizon adopted by the EEC supervisory authorities. The Finns were concerned primarily with mutual companies where resort to further capital was not normally an option and they were looking not only at the minimum requirements for continuing viability but also at the maximum strength of technical reserves which could be justified to the revenue authorities on the basis of the adverse contingencies which might be encountered in the future. As mentioned earlier, the Finnish equalization reserve forms part of the technical reserves and much of the Finnish study concentrates on this subject. The scope of the Finnish study and its implications for further work in the UK are considered in Appendix 1.

2.6.2 A major restraint on recommending a similar approach as an option in the U.K is the unfavourable disposition of the Inland Revenue towards such a liberal attitute to technical reserves. To build up substantial free reserves to correspond to the Finnish equalization reserve would be more difficult if

it had to be done out of taxed profits although this is in effect what the larger composites and reinsurers are doing by ensuring that their statutory solvency margin is covered quite generously. One can also argue that the full Finnish approach is unnecessary in view of the active capital market in the U.K. To restrict the scope of this report, we have not considered the need for equalization reserves but only the adequacy of technical reserves and solvency margin, to ensure the possibility of being able to run off the existing business satisfactorily.

2.6.3 A limited objective for this report, therefore, might be to lay down some of the elements which we believe should be taken into account in establishing prudent technical reserves and to put forward some ideas as to how one might assess a minimum solvency margin requirement consistent with this approach, to satisfy the needs of supervisors in relation to their ability to intervene in a company's affairs when it is getting into financial difficulties. Our conclusion is that there is a need either for regulations in respect of general business technical reserves, or for standards to be laid down by the actuarial and accountancy professions. We discuss some of the criteria which should be incorporated and suggest that reserves set up in order to satisfy these criteria ought to come to be regarded by the Inland Revenue as technical reserves to be set up out of pre-tax profits. An elaboration of our ideas for assessing the minimum solvency margin requirements would, on the other hand, provide a yardstick for judging the appropriateness or otherwise of the current EEC Non-Life Directive provisions.

2.6.4 Wider issues of the longer term financial strength of companies, the impact of trends and cycles and the capacity for growth, can be regarded as a suitable topic for further study, for which a modelling approach along the lines adopted in the Finnish study could prove invaluable.

3. ACCOUNTING FOR GENERAL BUSINESS LIABILITIES.

3.1 The Legislative Framework.

3.1.1 Every set of accounts prepared under the Companies Acts must give a "true and fair view" of the state of affairs of the company and of its profit or loss for the year. Insurance companies are, in general, required to comply with the requirements of what is now Schedule 8A of the Companies Act 1948, subject to a number of exemptions.

3.1.2 The main exemption which is of importance for outstanding claims is that from showing separately provisions and reserves and the movements thereon. A provision is defined as " a reasonable amount written off or retained by way of providing for any known liability, the amount of which cannot accurately be determined". Technically, therefore, it is a liability, whereas a reserve, which is defined as not including a provision, is free of known liabilities and forms part of the shareholders' funds. Insurance company technical reserves are, in strict accounting parlance, provisions rather than reserves, but the distinction is blurred because of the difficulties in assessing liabilities such as those in respect of outstanding claims and this may justify the special exemptions for insurance companies . The exemptions also legitimize the creation of hidden reserves by overstating liabilities. It can be seen that the position is asymmetric; it is permissible to overstate liabilities but not to understate them.

3.1.3 Turning now to Department of Trade Returns, which are not accounts in the usual sense, the Insurance Companies (Accounts and Statements) Regulations 1980 make it clear that the items shown for claims outstanding in the Returns are the amounts set aside at the end of the financial year for claims which have not already been treated as claims paid, including claims relating to business accounted for over a longer period than a financial year, claims the amounts of which have not been determined and claims arising out of incidents that have not been notified to the company. In addition, expenses, such as legal, medical,

surveying or engineering costs which may be incurred by the company, whether through the employment of its own staff or not, and are directly attributable to the settlement of individual claims which relate to incidents occurring before the end of the financial year, should be provided for. In the case of both claims and expenses, the amounts set aside may be reduced by any recoverable amounts.

3.1.4 Companies are also required to set aside an amount likely to be sufficient to meet that part of the company's general management expenses which would be incurred in settling outstanding claims should the company be closed to new business. Provision is further required to be made in respect of the unearned portion of premiums already received, including additional reserves if the unearned premiums are unlikely to be adequate in respect of the risks covered.

3.1.5 The Insurance Companies Regulations 1981 lay down rules for the determination of the amount of liabilities, although in the case of non-life business the regulations are in extremely general terms. Liabilities "shall be determined in accordance with generally accepted accounting concepts, bases and policies or other generally accepted methods appropriate for insurance companies". To examine further the nature of the problem, we will consider what accounting concepts, bases and policies are generally accepted, and the extent to which the methods and bases used are at present disclosed.

3.2 Fundamental Accounting Concepts.

3.2.1 Statement of Standard Accounting Practice No.2 (SSAP 2) defines fundamental accounting concepts as "broad basic assumptions which underlie the periodic financial accounts of business enterprises". It mentions four such concepts: the going concern concept, the accruals concept, the consistency concept and the prudence concept.

3.2.2 While the use of such concepts is not necessarily self-evident from an examination of the accounts, they have such general acceptance that their observance is presumed unless stated otherwise. They are practical rules rather than theoretical ideals and are capable of variation and evolution as accounting thought and practice develop. Let us examine the generally accepted meanings of these concepts to see how they apply to the special case of outstanding claims.

3.2.3 The going concern concept assumes that the enterprise will continue in operational existence for the foreseeable future. In particular, this means that the profit and loss account and balance sheet assume no intention or necessity to liquidate or curtail significantly the scale of the operation. As far as outstanding claims are concerned, this means that it is assumed that the company will survive long enough to discharge the outstanding claims, and therefore this must be reflected in the basis of valuation used for the liabilities. However, for expenses consideration would normally be given to the going concern level of costs, but on the assumption that new business would continue to be written to support those costs. This concept appears to conflict directly with the assumption underlying the Returns under the Insurance Companies Acts which is that the solvency of a company should be considered on a notional break-up basis.

3.2.4 The accruals concept requires that revenue and costs be recognised as they are incurred or paid and matched with one another so far as their relationship can be established or justifiably assumed. They are to be dealt with in the accounts of the period to which they relate, except that where the accruals concept is inconsistent with the prudence concept, the latter prevails. The accruals concept implies that the accounts should reflect changes in the amount of net assets which arise out of the transactions of the relevant period. Revenue and profits are matched with associated costs and expenses by including in the same account the costs incurred in earning them.

3.2.5 What are the implications of this for outstanding claims? The matching principle means that there must be brought into account the cost of claims incurred for risks undertaken for a particular accounting period, so far as this can be assessed , and it should be set against the corresponding earned premiums. The accounts should then show the changes in net assets arising out of the transactions for this period. However, this still begs the question of what basis should be used to value outstanding claims.

3.2.6 The consistency concept requires there to be consistency of accounting treatment of like items within each accounting period and from one accounting period to another. Its implications for outstanding claims seem self-evident.

3.2.7 The concept of prudence requires that revenue and profits are not anticipated, but are recognised by inclusion in the accounts only when realized in the form of cash or other assets, the ultimate cash realization of which can be assumed with reasonable certainty. Provision must be made for all known liabilities whether the amount of these is known with certainty or is a best estimate in the light of the information available. It should be noted that this concept is asymmetric, in that the recognition criterion for revenue and profits is more stringent than that for expenses and losses.

3.2.8 Since outstanding claims are a liability which is unlikely to be able to be assessed with certainty, the prudence concept dictates that nothing less than a best estimate should be incorporated. What is a "best estimate" is nowhere defined, but it seems reasonable to assume that it should take account of anticipated inflation and trends in future settlements. However, there is no reason to suppose that it should necessarily incorporate any margins over and above a mean estimate.

3.2.9 It is clear from the above that fundamental accounting principles do not take us very far in relation to an appropriate standard for accounting for general business liabilities. There is no Statement of Standard Accounting Practice which has any

special application to general business insurance companies, so what is generally accepted must be deduced from the empirical evidence of companies' returns and accounts.

3.3 Empirical Evidence

3.3.1 In an endeavour to establish what is generally accepted accounting practice, the published accounting policies of the seven largest quoted composites plus the two quoted life offices with substantial non-life portfolios were examined. These are set out in Appendix 3, together with a summary in tabular form of the principal features.

3.3.2 The Commercial Union, Eagle Star, GRE and Legal and General feel that it is necessary to state that full provision has been made for outstanding claims. The Royal state that they have included the estimated cost of all claims incurred, which may amount to the same thing, although on the face of it, it sounds less strong than "full provision". Only General Accident and GRE state specifically that the provisions take account of expected inflation and future trends in settlements. General Accident state that provisions are based on case estimates, the only office to refer to the method employed. Legal and General make a partial reference to method in respect of overseas workmen's compensation, where the provisions are stated to have been discounted. Further consideration will be given to this particular aspect of accounting policy in Chapter 7 of this report.

3.3.3 Every one of the companies in the sample refers to the inclusion of claims incurred but not reported (IBNR). It would seem clear that this is a liability arising from risks already expired which is not known with certainty, and therefore must be included in the best estimate of the cost of outstanding claims in the light of the information available. Once again, General Accident is the only office which discloses anything about the method used.

3.3.4 Some offices spell out the fact that the provisions can only be approximate. GRE points out that outstanding claims are not capable of precise assessment, and the Commercial Union stresses the need for judgement and experience. A necessary consequence of this uncertainty is that revisions are often required in later years. This is referred to by Commercial Union, Eagle Star and General Accident. Such adjustments may be material. This is recognised in the Insurance Companies (Accounts and Statements)Regulations 1980, which require claims paid and outstanding arising from incidents occurring in the financial year to be distinguished from any change in the estimated cost of claims arising out of incidents occurring in previous financial years. In this way, it is possible to see the result of the current year's underwriting, without the distortion of adjustments to earlier years, and to track the company's record of under or over-estimation of liabilities.

3.3.5 The Commercial Union and the Legal and General make specific reference to providing for the administrative expenses to be incurred in settling outstanding claims. This appears to be in accordance with the requirements of the regulations to provide for the management expenses involved in settling all outstanding claims. However, as mentioned above, it is arguable that making such a provision is contrary to the "going concern" concept. Indeed, this is one of the reasons why the auditors' report in the Returns to the Department of Trade and Industry no longer refers to a "true and fair view" and merely certifies that the forms "have been prepared in accordance with Insurance Companies (Accounts and Statements) Regulations 1980."

3.3.6 The evidence would suggest that there is not much consistency between the claims estimating procedures of different companies. The reserve for outstanding claims is probably the single item in an insurance company balance sheet which is most subject to uncertainty and where there is the greatest variation in strength of reserving from company to company, but practice also varies widely in relation to the provision for future expenses.

3.3.7 In the Returns under the Insurance Companies Acts, information is provided about the timing and variability of past cash flows, which may be of assistance in assessing future uncertainty. If the development of claims costs is regarded as a stochastic process, then it may be argued that the uncertainty may be measured by deriving some measure of the variation which the run-off of past claims has exhibited. A satisfactory system of reporting for non-life insurance companies would have to provide enough information for the reader to assess the extent to which the potential variability of the claims run-off has been provided for and lay down a minimum standard of acceptable provision, at least in general terms.

3.3.8 Turning to the assets side of the balance sheet, it can be seen that, of the seven companies in our sample, four value their investments on a market value basis and three on a book value basis. Book value is, broadly, the cost of the investments (regardless of when they were bought) less hidden reserves. Clearly, this tells us nothing about the amount, timing or uncertainty of the future cash flows we may expect these assets to generate.

3.3.9 However, when it comes to submitting returns to the Department of Trade and Industry, all the companies have to value their assets on the basis prescribed in the Insurance Companies Regulations. The basis laid down in these Regulations is, in general, market value, with a few exceptions for certain specific types of asset. This might be expected to give a greater consistency of valuation between companies. There are, however, two reasons why the same assets could be valued differently by individual companies:

(a) The Regulations prescribe a maximum value for certain particular types of assets (e.g. property); a company could therefore include a value which was less than that for which the Regulations provide; and

(b) The Regulations provide that where it appears that an asset is of a value lower than that specified by the Regulations, the lower value must be used.

Despite this, however, there can be no doubt that the operation of the Valuation Regulations enhances the comparability of insurance company balance sheets.

3.3.10 It has been mentioned that the Regulations prescribe a basis of valuation that is, broadly, market values. It can certainly be argued that the value the market places on a particular investment is based on the collective view of the amount, timing and uncertainty of the future cash flows which that asset will generate. The market view will be determined by the financial situations, tax positions etc., of all the investors in the market, which may well differ from those of the insurance company. Consequently, it may be argued that the value of a particular asset to an insurance company is not necessarily the same as the value placed upon it by the market, and, therefore, that market value may not necessarily be the most appropriate method of valuation to adopt. Consideration must certainly be given to the relationship between the assets and the liabilities against which they are held, and provision should be made (or free assets held) to cover possible changes in the value of the assets which could result in their being inadequate to meet the liabilities at the time they are required to be realized.

3.4 The Scope for Change.

3.4.1 The purpose of financial statements is to give information about the financial situation, progress and prospects of a business. However, it is unrealistic to suppose that they can give a complete and accurate picture of the worth of an enterprise and of changes in its value over time, or that they can measure its financial failure or success in a quantitatively precise way. In particular, there is the problem of uncertainty. The preparation of any set of financial statements inevitably requires estimates to be made about the

future. In making such estimates, there can be conflict between the desire to be prudent and the desire to match costs and revenues realistically to different periods. Further, estimates may change, with the result that the financial statements for the present period must include the effects of the changes on previous estimates. Any rules made to deal with this problem must not only be pragmatically justified but also allow for the exercise of professional judgement if their application is not to produce arbitrary effects.

3.4.2 The evidence suggests considerable lack of consistency in the treatment of liabilities, in particular those in respect of outstanding claims. Since the variable being dealt with here is a stochastic one, it may be argued that a single point estimate is inadequate. This line of argument would seem to suggest that some disclosure of the underlying distribution might be appropriate. Indeed, many of the problems in relation to demonstrating solvency can be interpreted as arising from the fact that insurance company accounts attempt to deal with probabilistic phenomena in a deterministic manner. Perhaps the way forward is to develop financial statements which can adequately present the dimension of uncertainty which is lacking in conventional accounts. At the very least, accounting standards should define whether the technical reserves are intended to cover the mean estimate of the liability, or the mean plus a multiple of the standard deviation to cover the variability in the run-off.

3.4.3 Only when one has defined more clearly the scope of the technical reserves can one discuss appropriate standards for an explicit solvency margin. The dividing line is of necessity fairly arbitrary. Whilst it would be difficult to reconcile with standard accounting concepts the inclusion in technical reserves of provision for essentially unquantifiable risks, such as fraud or breakdown of management control, the appropriate provision for outstanding claims might more readily be made the

subject of a standard. Such ideas are developed further in Chapter 4 of this report, but it may be helpful to put forward a suggestion at this stage.

3.4.4 In our view, an appropriate level of technical reserves, having regard to the arguments in paragraph 2.4.6 about the need for adequacy to ensure a reasonable likelihood of an orderly run-off without the protection of an additional solvency margin, might be based on the mean plus at least one standard deviation. A more satisfactory theoretical basis might be devised in terms of risk of ruin, where one could argue for technical reserves sufficient to run off the business with a risk of proving inadequate of, let us say, 1/100, whilst the additional solvency margin might be envisaged as reducing the risk of ruin to, say, 1/1000.

3.4.5 The figures are, of course, arbitrary, and cannot readily be related to a basis defined in terms of standard deviations without assuming an underlying distribution. In principle, the standard deviation is meaningful only in the context of a distribution, but it is possible to derive estimators from the crude data of an individual company, which might make possible the practical application of what might otherwise remain an abstruse theoretical concept.

3.4.6 More work than the Working Party was able to embark upon would be needed to look at the relationships between a risk of ruin approach and a standard deviation approach in terms of possible distributions. What is needed, however, is a workable standard of adequacy of technical reserves, on top of which the solvency margin requirement can rest. The solvency margin must in principle cover the effects of a much wider range of possible variability in the level of outstanding claims and expenses than do the technical reserves, perhaps up to about three standard deviations above the mean. In addition it must include a significant, but most probably arbitrary, element to provide a buffer against the risks of a non-quantifiable nature which could nevertheless in a short space of time undermine the financial stability of the company.

4. VARIABILITY OF LIABILITIES

4.1 The Need for Margins

4.1.1 The previous chapter has stressed the need, in our view, for technical reserves to be more than just the expected value of the outcome. In practice this is very much the view taken by the larger composite offices, although the extent of the margins built in to the technical reserves nevertheless differs markedly from company to company. There may in some cases be a deliberate decision to lock away additional solvency margin cover within the technical reserves because of the charge to tax if such amounts were released to general or equalization reserves. Prudence also dictates that proper allowance be made for the inherent uncertainties, with tax considerations providing a further incentive for conservatism because of the danger of declaring taxable profits and subsequently needing to inject money to strengthen technical reserves.

4.1.2 Whilst such prudence has come to be expected of the larger quoted companies, it is nevertheless a mantle voluntarily assumed. Many other companies find themselves under pressure to keep technical reserves to the minimum acceptable level, either because they are undercapitalized and need to show free assets at as high a level as possible to satisfy statutory solvency margin requirements, or because of a desire to pay the maximum possible dividend. It is at this end of the market, and with respect to the large number of companies operating on relatively slender free asset margins and with a high degree of uncertainty attaching to the level at which outstanding claims may be settled, that minimum standards for valuing the liabilities would have most impact.

4.1.3 For the purposes of this chapter, we define

$$Lp = Le + M1$$

where Lp is the published value of the liabilities
Le is the expected value of the liabilities
M1 is the margin in the liabilities as published

Similarly,

$$Ap = Ae - M2$$

where Ap is the published value of the assets
Ae is the expected current value of the assets
M2 is the margin in the assets as published

Although we are concerned in this chapter primarily with the liabilities side of the balance sheet, it may be helpful to recognise at this stage the possibility of margins on the assets side as well. This may apply in particular to some of the well-established offices, but we have already commented on the fact that, as far as statutory returns under the Insurance Companies Acts are concerned, the scope for retaining margins in the published values of assets is limited to only a few categories of assets where the regulations prescribe a maximum figure.

4.1.4 It will be appreciated that the actual values of assets and liabilities will only be determined by the passage of time and will probably be different from both the published and expected values. However, for our present purposes we will assume that Le and Ae are best estimates of the ultimate actual values. The published solvency margin PS is given by:

$$PS = Ap - Lp$$

The actual solvency margin may be estimated as:

$$AS = PS + M1 + M2$$

Although asset valuation regulations should ensure that M2 is

non-negative in relation to the best available estimates of asset values at the balance sheet date, it is clear the margin could become negative relative to Ap if the market falls. This is considered in the next chapter. Suffice it to mention here that we do not see much scope for insisting on a positive margin to be built into the published asset values to cover this point, but the required minimum level of published solvency margin should be large enough to provide a buffer against this contingency.

4.1.5 In the absence of any standards applicable to the determination of liabilities, we cannot assume that M1 will be positive. Indeed the evidence suggests that it is not infrequently zero or negative. One reason for this may be that future investment income has been explicitly or implicitly taken into account. We will examine the justification for that in Chapter 7. It should also be noted that it is essential that the values placed upon the assets and the liabilities should not be considered in isolation. There should in principle be a consistency of approach, although the practical application of this is more difficult to follow through than in the case of long term business.

4.1.6 A company clearly has an obligation to show a published solvency margin in excess of that required by the statutory authorities, if it wishes to continue to be permitted to write business. However, prudent management will wish to maintain an adequate level of solvency margin over and above the minimum. Some of the factors to be taken into account are:

(a) the ability to meet existing commitments with a high degree of probability, having regard to the portfolio of business underwritten;

(b) the need to be able to seek and obtain new business without undue restraints;

(c) the aim of showing a reasonable profit performance in both the short and long term, with a view not only to paying dividends but also to maintaining an adequate level of solvency margin;

(d) the ability to withstand periods of difficult underwriting conditions; and

(e) the desire to show a satisfactory return on capital employed.

4.1.7 Not all of these requirements necessarily point in the same direction. In particular, the need to show a satisfactory return on capital is a constraint on increasing solvency margin cover by raising new capital. On the other hand, the existence of a strong solvency margin may improve the company's competitive position and permit greater flexibility of investment policy, with a view to maximizing the return on the assets.

4.1.8 From the point of view of the supervisory authority, and other third parties concerned about the security offered by a company, the horizon will be more limited. However, it is not sufficient for attention to be concentrated on the published solvency margin unless one can be satisfied that the margins M1 and M2 are non-negative. Furthermore, if it were to be accepted that M1 and M2 could both be zero, the required minimum level for the published solvency margin would have to be set appropriately. The origins of the EEC Non-Life Establishment Directive, which lays down the minimum standard of solvency margins for insurance companies operating in the countries of the European Community, suggest that initially consideration was given to a level of technical reserves based on expected values, with a solvency margin set so as to produce a risk of ruin of 1/1000 over a three year period.

4.1.9 However, the solvency margins produced were thought to be too high in relation to those already maintained by prudent company managements, and it was recognized that this reflected

a more stringent approach to the technical reserves rather than a weaker standard of solvency. Although the Directive only lays down that "Each Member State .... shall require the undertaking to establish sufficient technical reserves", this has been interpreted by the EEC supervisory auhtorities to imply a standard significantly stronger than mean estimates. More details of the development of the current EEC solvency margins and the implications for technical reserves can be found in a paper submitted for the 22nd International Congress of Actuaries in Australia by one of the members of the working party[2].

4.2 The Scope of the Problem.

4.2.1 The principal components of the liabilities of a general insurance company are as follows:

(a) Unearned premium reserve (including additional amounts in respect of the unexpired risks where the premiums may be inadequate);
(b) Reserve for reported outstanding claims (including claims where the amount is still unknown);
(c) Reserve for claims incurred but not reported;
(d) Reserve for future management expenses if company was closed to new business;
(e) Reserve for catastrophes;
(f) Other special reserves; and
(g) Current liabilities

4.2.2 The first three of these are in the nature of what an accountant would term provisions, although in each case there is considerable uncertainty about the amount of the liability. The fourth item would not normally be considered appropriate in a company's accounts, but it is required for the purposes of returns to the Department of Trade and Industry. Items (e) and (f) are not usually treated as technical reserves but as earmarked free assets, since they may be held against events in

future periods for which the company is not even yet on risk. In so far as they relate to as yet unknown large claims or aggregations of claims in respect of premiums already received, it would be appropriate to make provision under (a) and (c).

4.2.3 Among the numerous factors which may affect the value of the liabilities and the ability of the company to meet them are:

a) Inflation
b) Legislative changes
c) Court case judgements
d) Reinsurance
e) Numbers of claims
f) Claims settlement rates
g) Existing premium rates
h) Investment income
i) Expense control
j) Weather and natural disasters
k) Other social and economic factors
l) Changes in value of assets

4.2.4 From the above it is clear that the value of the liabilities is dependent on many factors, most of which are not within the control of management. Neither is it possible to estimate their effect accurately. For this reason prudent company management will adopt a conservative approach when valuing the liabilities, having regard to all the known facts and circumstances. As has already been noted, there are also tax advantages in such a policy.

4.3 Estimating Variability

4.3.1 We now focus our attention on measuring the variability inherent in the reserves for outstanding claims (including IBNR). For some types of business (e.g. travel insurance) the estimation of outstanding liabilities will be quite easy and the variance attaching to such estimates will be small. For other

types of business (e.g. liability), the variance about the expected outcome will be quite large. If we have classes of business $[\alpha_1 \ldots\ldots \alpha_n]$ let us assume that the expected outcomes for each class are $[\mu_{\alpha_1} \ldots\ldots \mu_{\alpha_n}]$. Suppose that the variances for the various classes are $6^2_{\alpha_1} \ldots\ldots 6^2_{\alpha_n}$ and that $L_{\alpha_1} \ldots\ldots L_{\alpha_n}$ are the published values attaching to the liabilities for the different tranches of business.

then we have $$L_{\alpha_i} = \mu_{\alpha_i} + K_{\alpha_i} 6_{\alpha_i} \quad \text{etc}$$

where K_{α_i} is a margin factor chosen, explicitly, or more usually, implicitly, by the company.

Summing for all classes we have -

$$Le = \sum \mu_{\alpha_i}$$
$$Ml = \sum K_{\alpha_i} 6_{\alpha_i}$$
$$Lp = \sum L_{\alpha_i}$$

Lp are the published figures and thus freely available. Le, the expected value of the liabilities, may well be known to the management but is not available directly to third parties.

4.3.2 Ideally, one would like to find a way of estimating K_{α_i} so as to be able to assess the strength of the reserves held. This inevitably presents considerable problems, and any method is likely to be open to criticism. However, looking at the problem from the other end, it would not be so unreasonable to set a standard for reserving in terms whereby K_{α_i} must be greater than or equal to, say, unity. This would leave the methodology for arriving at the mean estimate and the variance to the discretion of the company, whilst still making it clear what factors ought to be taken into account in assessing the liabilities. It would not be enough simply to have regard to case estimates, since this gives no independent view as to the existence of any margin over and above a mean estimate. In principle all reserves

should be certified by a loss-reserving specialist capable of making the necessary judgements about the variability of the liabilities.

4.3.3 It is clear that a standard as outlined above would imply different levels of margin, relative to the mean estimates of the liabilities, for different classes of business, depending on their variability. A similar argument should be carried forward to assessing the level of required solvency margin, if the latter is to have any real meaning as part of a consistent framework of control. One might postulate for example, that the solvency margin for each class of business should correspond to two standard deviations, bringing the total provision (technical reserves plus solvency margin) up to a level equivalent to three standard deviations above the mean. If the outstanding claims amount is considered to be a normally distributed random variable, total provision of $(\mu + 3\ 6)$ would reduce the probability of it being proved inadequate to approximately 1/1000. Technical reserves based on $(\mu + 6)$ however, would be likely to be inadequate 16 per cent of the time. It might be thought that reserves based on $(\mu + 1.5\ 6)$, reducing this fraction to 7 per cent, would be a more satisfactory standard. Of course, the distribution may be very different from a normal distribution, and one would need to decide whether to set the standard in terms of risk of ruin, or in terms of variance. The latter is likely to be more practicable, since it can be estimated without presupposing a particular distribution hypothesis.

4.3.4 Of course, such an approach begs the question of whether an adequate method can be devised for measuring the variability of the outstanding claims estimate. The majority of triangulation methods which have been devised so far are suitable only for producing a point estimate of outstanding claims. Whilst a battery of methods, or a subjective range of projection factors, can be used to obtain some idea of the possible spread of results, this falls some way short of an estimate of the underlying statistical variance. Dr G C Taylor,

in a paper[3] presented to ASTIN in 1982, sets out a possible approach using regression analysis. It seemed to us that his approach merited further investigation, but we have not been able to follow it up with any numerical studies in the time available to us.

4.3.5 We have instead pursued some ideas propounded by a member of the Working Party in an unpublished paper[4] , in which past run-off data are used to model the variability of estimated outstanding claims at successive durations. The paper goes on to show how, with an assumption about the underlying distribution, the results of the analysis can be used to construct probabilistic accounting statements. Whether this would be an appropriate method to use in practice remains to be seen. For our purposes we were concerned with examining whether there was a straightforward way of establishing a mean estimate of outstanding claims and an associated variance which could be used to attach meaning to the concepts described above. Details of the method and some of its problems are given in Appendix 4. Some results from applying this method to the published claims settlement analyses of a number of companies are given in Appendix 5, together with comparisons of the mean estimate of outstanding claims with that given by other methods.

4.4 The Significance of the Margin Factor.

4.4.1 As has already been implied, the question of the size of the margin factor can be approached from two quite different standpoints. It would have particular significance for the company if regulations or accounting standards insisted on the variability of the claims run-off being taken properly into account, with reserves being established on a basis not weaker than $(\mu+K\sigma)$ for some specified K. It is for consideration whether any guidance is needed on methods to be regarded as appropriate for determining μ and σ.

4.4.2 More research is clearly needed in this area and it may be that a variety of methods may be appropriate in different circumstances, but that K might be set at 1.5 rather than 1 to provide an additional margin to offset weaknesses in the

methodology. It is not hard to envisage a hard-pressed company selecting the method which resulted in the lowest values of μ and 6 , and it would be difficult for an accounting standard to veto particular methods or outlaw the practice of choosing the most favourable result.

4.4.3 Seen from the rather different angle of the supervisor, or other independent observer, a similar methodology to that developed in the previous section could be used to assess the strength of companies' existing reserves, even in the absence of any specific standard of reserving, as a means of identifying possible underprovision. This would still be necessary even if an accounting standard were to be introduced, as an independent check that the standard had been adhered to and that it had not been applied in an unsatisfactory way.

4.4.4 Whilst there may be criticism of any particular method of calculating expected values and variance, which might be used to test the strength of reserves, such criticism would not detract from the fact that a system along the above lines would pay heed to the variance about expected values and attempt to assess their potential effect and that there would be a consistent method applied to all companies. It is not suggested that the absolute values of the margin factors for any one year would necessarily be significant in their own right, but the observations and inferences to be drawn from a set of figures for a number of consecutive years could be informative.

4.4.5 The value of the Ks will depend on a whole host of factors and their interplay within the circumstances of a particular company. Some of the factors that may affect the K values are as follows:-

(a) Whether company is mutual or not and its standing in the market. For a mutual company in inflationary times there may be a need to show that its published solvency margins are similar to those of its competitors and this may cause it to retain a small margin M1 in the technical reserves and a small K_1

margin factor. Also a company with ready access to cash from its parent (or from shareholders) may feel content to have smaller K_1 than a company that did not have such ready access.

(b) Portfolio mix and business written

If new business is directed more towards liability business or other business which has larger variance than the existing portfolios, this would tend to increase 6 and thus reduce K_1, the liability margin factor, unless the absolute size of margins was appropriately increased. A trend towards lower variance business would have the opposite effect.

(c) Type and amount of reinsurance

Other things being equal, an increase in the amount of reinsurance will lower the variance and thus increase the margin factor, unless margins are released to profit.

(d) Amount of solvency margin or free reserves

Companies with considerable free reserves are likely also to have a large K_1 margin factor, whilst the "weaker" offices cannot afford to strengthen reserves to this extent, although in principle they should have the larger margins in their technical reserves.

(e) Amount of profit the company wishes

Increasing K_1 and thus the published value of liabilities will reduce the profit and thus the Ks can be used by management explicitly or implicitly to smooth out profits.

(f) Future new business and related planning policies

If a company is envisaging a strong marketing drive it may reduce its K_1 margin factors and increase the published solvency margin PS, so that solvency can be clearly displayed, even if new business strain is encountered. Alternatively, a steady reduction in K_1 may be used to finance the strain on setting up reserves for new business.

(g) The underwriting cycle

At time of underwriting 'prosperity' there would normally be an attempt by management to save some of

the 'fat' for the leaner years that are to follow. This could be done by increasing K_1 and releasing the margins subsequently.

4.4.6 Similar arguments may apply to margins on the assets side, although, as we have already noted, for most companies there will be less scope to make adjustments there because of the asset valuation regulations, at least as far as the returns to the Department of Trade and Industry are concerned.

4.4.7 In summary, there are a number of constituent parts making up the total assets and liabilities of a company. There are numerous factors which can affect the mean value of these assets and liabilities and, depending on their make-up, different variance attaching to the mean estimates. Taking into account a large number of other factors, published valuations of assets and liabilities will be arrived at, such that:

$$Lp = Le + K_1 6_2$$
$$Ap = Ae - K_2 6_2$$
$$PS = Ap - Lp$$

The interplay between the above elements is one of the major problems facing general insurance management. A coherent policy, bearing in mind the margin factors in both the assets and the liabilities, is desirable.

4.5 The Margin Factors and Profit Equalization

4.5.1 For most companies the outstanding claims reserve (including IBNR) forms the largest part of the liabilities. It is interesting to examine the relationship between claims reserves and profits both for well-established offices and weaker companies. In the table below we show figures for incurred claims. These are defined as:

Incurred Claims = Outstanding Claims Reserves Carried Forward
+ Claims Paid
- Outstanding Claims Reserves Brought Forward

The outstanding claims reserves are deemed to include IBNR. It is expected that the incurred claims figures will be of much the same order as the outstanding claim reserves carried forward except, perhaps, in periods of rapid change (either in inflation or in growth).

4.5.2 The table below show incurred claims and the profits declared for 1981 and 1982 for a few well-established companies.

Company	Incurred Claims	Profit	Profit as % of Inc. Claims	Profit (excluding Life & Assoc.Cos.) as % of Inc.Claims
1981				
GRE	628	89	14	12
Eagle Star	322	74	23	14
G.A.	716	105	15	14
Sun Alliance	419	71	17	16
Phoenix	283	30	11	9
C.U	1,043	68	7	5
Royal	1,030	118	11	10
Cornhill	99	7	7	7
1982				
GRE	725	106	15	12
Eagle Star	352	68	19	10
G.A	966	45	5	4
Sun Alliance	565	57	10	9
Phoenix	330	15	5	5
C.U	1,397	14	3	(2)
Royal	1,267	42	8	7
Cornhill	111	6	5	5

The differences between the Profit/Incurred Claims ratios (excluding profits from long-term business and from associated companies) for the different companies are remarkably small. As the profit is the final item of an equation in which one is

dealing with much larger numbers it is almost certain that well established offices are introducing a certain amount of smoothing into their profit figures by manipulating the margin factors in the assets, and, particularly, in the liabilities.

4.5.3 It may be noted that a change of 2½ percentage points in the future inflation rate assumption may lead to a 6% difference in the total outstanding claims reserves and that would represent an increase or decrease in profit of some 50% for an office which has a profit to incurred claims ratio of 10%. Such a divergence in opinion as to future rates of inflation which it is prudent to allow for can easily occur between two different managements. It would be naïve to think that no manipulation of the liabilities (or assets) occurs in arriving at the desired level of profit. In this respect the K's could be regarded as profit equalization factors in much the same manner as the fluctuation or equalization reserves of some overseas companies.

4.5.4 The profit to incurred claims ratios were also calculated for some less well-established offices. The percentages are shown in the table below:-

Company	Profit as % of Inc.Claims
A	-6
B	13
C	10
D	5
E	20
F	0
G	11
H	30
I	41
J	15

With these companies the range of percentages is much wider, from -6% to 41%. The figures suggest that we may be dealing with a totally different set of financial considerations.

4.5.5 These companies may not have such a wide spread of risk and there could be a strong case for them to have larger K factors than the well-established offices. However, the wide range of percentages above tends to indicate that there has been no build up of large liability or asset margin factors and the constraints of capital, the demands of shareholders and the need to display a statutory solvency margin may lead to much smaller K factors than those strictly required for their limited spread of risks and size. For these companies the problems are, of course, much greater for both supervisory authorities and company management. A standard set of valuation principles would help the authorities to know where they stand, and would strengthen the hand of prudent managers in discussions with shareholders.

4.6 Patterns in the Margin Factors

4.6.1 As has been noted above, the values in any one year of PS, K_1 and K_2 (although it may be on these that the supervisor has to decide whether further investigations are required) may not be as informative as the trend over a number of years. It must also be remembered that the values of K_1 and K_2 deduced by a third party may be quite different from values explicitly or implicitly assumed by the company management. Management will have far greater knowledge of the portfolio of business that they write and will be in a much better position to estimate μ and 6. The supervisor (or other third party) will be forced to use a much cruder statistical method and will usually not have the time or the information to investigate the underlying portfolio in any great detail. However, if alarm signals are shown by the initial investigation a more detailed examination could then be undertaken. We now look at various patterns of K_1 factors.

4.6.2 A steady fall in the value of K_1 over a number of years could be for any of the following reasons:-

(a) With an expansion of the business and a better spread of risk there may be a management decision that a smaller margin factor will suffice;

(b) To ensure that the solvency margin can be demonstrated K_1 may be reduced. In particular there may be a need to increase the solvency margin as more business is written and one way of doing this may be to remove the margin in the liabilities;

(c) From the top to the bottom of an underwriting cycle there may be a gradual erosion of the margin factors as margins are used to withstand the adverse effects of the underwriting cycle so that profits are not unduly affected;and

(d) A slide towards insolvency can be disguised by steadily reducing the margin factors, whilst still showing a respectable published solvency margin.

4.6.3 Steadily increasing margin factors over a number of years may be the result of any of the following set of circumstances:-

(a) The desire to lock away some of the profits in order to equalize profits over a period, and to avoid undue tax charges;

(b) Margins might be increased in a period when the underwriting cycle is favourable to provide a buffer for when it turns;

(c) Further margins may be created at times when the published solvency margin might otherwise seem too high for the published accounts; and

(d) A gradual fall in the margin factor on the assets side may lead management to increase the margin factor on the liabilities side and vice versa.

4.6.4 It is to be noted that to find the actual cause of a change in K_1 over a number of years or from one year to the next may require further investigations. These would include

examining the claims run-off statistics and new business figures. Some movement in the margin factors will occur because of random fluctuations and because of shortcomings in the methods of estimation, so the derivation of implicit margin factors could only be used as one possible test for a third party observer to apply. The minimum margin factor ought, however, to be a fundamental element in the company's own assessment of prudent technical reserves.

5. VARIABILITY OF ASSETS

5.1 Asset Valuation

5.1.1 The solvency margin of a non-life insurance company is the difference between the value of the assets and the value of the liabilities including provisions . Assessment of provisions involves a large element of forecasting the future and so is a very imprecise exercise. Normal market practice, therefore, is to formulate a conservative valuation of provisions, with a margin over the payments which the company, on its best estimates, expects to make.

5.1.2 Asset valuations are rather different. In the U.K, insurance companies are required to value their assets on the basis of current market values for the purposes of returns to the Department of Trade and Industry and the same basis is frequently used for shareholders' accounts. There can be implicit margins in certain limited cases, notably property values. Property, however, comprises only 12 per cent of the assets of U.K general insurance companies and virtually all of the other assets are susceptible to a fairly precise market valuation. In these circumstances the implicit margins in asset valuations must be described as virtually negligible for most companies.

5.1.3 As already discussed in paragraph 3.3.10, use of market values is not entirely satisfactory. The most important advantages of market values for solvency monitoring are that they can be calculated with a high degree of objectivity and that they approximate reasonably closely to the cash sum which would have been realized if the assets had had to be sold on the balance sheet date. Other asset valuations may be used for other purposes. Some variation on historic cost is sometimes used in shareholders' accounts. However, historic cost for an investment portfolio is subject to manipulation by selective dealing. We have suggested that the focus of interest should be on the future cash flows likely to arise from an investment

portfolio, and valuations may be derived by discounting these cash flows with appropriate assumptions. The assumptions underlying such valuations are subjective and are, therefore, less satisfactory for use in financial reporting. In any case, the market value may be seen as a consensus valuation of likely future cash flows at a market interest rate.

5.1.4 Apart from the possibility of manipulation, historic cost valuation can lead to inconsistencies and does not necessarily produce margins. The very large overvaluation of bond portfolios in the U.S resulting in the years 1979 to 1981 from the use of historic costs is a particularly striking example. The Working Party would support the U.K practice of using market values in balance sheets because of their objectivity but would emphasize that this necessitates a different treatment from liabilities, where we are concerned with the appropriate level of implicit margins. Explicit margins are needed to cover variability in asset values.

5.2 Changes in Asset Values

5.2.1 The current market value of assets can be assessed with quite a high degree of precision. We are, however, concerned with solvency over a period, whether long term or short term, and so the necessary amount of solvency margin to take care of fluctuations in asset values depends on an assessment of how much capital could be lost if market values were to fall. Probabilities could, in theory, be attached to certain percentage losses on various investment categories. The various investment sectors do not move independently - they are strongly related - but if sophisticated statistical techniques were used it would be possible to construct some sort of model for the necessary solvency margin to cope with the investment risks of various asset distributions. There are, however, several objections to this sort of procedure:

(i) Asset distributions are rarely kept stable for very long;

(ii) Market structures change with time and only the last ten years, or, at the most, 20 years, could be considered relevant. This means that the area of uncertainty in the probability distributions is very large.

5.2.2 It is suggested, therefore, that a very simple ad hoc approach is likely to produce as good an answer as a more sophisticated method. For example, to approximate to, say, a very high confidence level, suitable "worst case" factors might be:

Sector	Change in Value
	%
Fixed interest	-25
Equities - U.K and Overseas	-60
Property	-50
Index Linked	-20

It is unlikely that all of these changes would happen at once, even though the markets are correlated, but the relationship is extremely difficult and may be impossible to analyse in any quantitative way.

5.3 Avoiding the Risks of Asset Variability

5.3.1 In paragraph 3.3.10 reference was made to the need to give consideration to the relationship between the assets and the liabilities against which they are held. Matching of assets and liabilities is a well-established principle in life assurance. However, it is less easy to apply to non-life insurance. In general, sudden changes in the market values of the assets will have a direct impact on the declared level of solvency margin, since there is little scope for making any compensatory adjustments to the value of the liabilities. The main exception to this is where fixed interest securities are held and the technical reserves have been discounted. In this case a fall in the value of the assets may be able to be reflected, at least to a partial extent, in a higher valuation rate of interest and hence a lower value for the liabilities.

5.3.2 Although investment in fixed interest securities and corresponding discounting of liabilities enables some of the volatility of the asset values to be compensated for in the amount of the liabilities, fixed interest securities may not provide a very satisfactory match in other respects. The lowest risk investment would appear to be one which matches both the approximate timing and amount of the claims run-off. This would imply a relatively short average time to maturity, except for certain long-tailed business, and some degree of inflation protection. This suggests that the ideal investment might be something like a five year index-linked gilt. However, if a reasonable inflation assumption can be made, short dated fixed interest stocks may be an alternative.

5.3.3 If liabilities are not discounted, there will be no compensating adjustment to their value when asset values fall. Fluctuations in the margin of assets over liabilities can only be avoided, therefore, by investing in cash on deposit, where the capital value does not vary. This highlights the difficulty of determining a low risk investment strategy for a general insurance company. The best investments to match the liabilities may still result in a volatile balance sheet, whilst stable asset values can only be ensured by exposing the office to losses if inflation accelerates or interest rates rise.

5.3.4 In the face of commercial pressures, companies try to maximize their total investment returns, net of tax. This, however, involves adopting a riskier investment strategy and therefore increases the desirable level of the solvency margin. The balance between potential reward and extra investment risk is very complex to assess and it is necessary to model the position of any individual company. The example presented below shows the sort of analysis as regards investment which could be included in such a model. Stability of investment values is an important aim. Companies which are going concerns do not usually have any great cash flow requirements and so term to redemption is not in itself a crucial quantity.

5.4 Influences on asset values.

5.4.1 General insurance companies hold assets in a number of investment sectors, and the distribution of assets for an average U.K company may be estimated as follows:-

	%
Gilts - fixed interest and index linked	34
Debentures and Loans	11
Equities - U.K	28
- Overseas	5
Property	12
Cash	10
	100

5.4.2 A wide variety of factors influence the market values of these assets and many of these factors are inter-related. Among the main influencing factors are:

(i) interest rates
(ii) inflation
(iii) profitability and dividend policy of companies whose shares are held
(iv) financial position of companies whose shares are held
(v) taxation
(vi) property rentals and growth prospects
(vii) currency exchange rates

These factors will affect different investment sectors in different ways and some may indeed have opposite effects on different sectors. For example a rising inflation rate would be expected to be an adverse influence on fixed interest markets but a favourable factor for index linked gilts. It is very difficult to predict which factors will influence which markets, let alone how the economic influences will vary, and with sparse data the main risk is that of drawing invalid conclusions, The best assumption to make in the sort of analysis described, and one which does not really reduce the value of the analysis, is that the "worst case" outlook would apply to all markets at the same time.

5.5 The Effect on Solvency

5.5.1 The following illustrative figures are based on a company with annual premiums of £100m and a solvency margin of 70 per cent.

XYZ Insurance Company
Consolidated Balance Sheet

	£m
Shareholders Funds	70
Represented by	
Investment assets	195
Less	
Underwriting provisions	125
	70

Supposing the asset distribution to reflect the distribution of the average non-life insurance company based on government statistics, the assets would be as follows:-

	%	£m
Fixed Interest	45	84
Equities - U.K	28	54
- Overseas	5	10
Property	12	23
Cash	10	20
	100	195

5.5.2 It is difficult to decide how severe a fall in asset values can reasonably be expected to be covered but we would suggest at current levels that it would be prudent to plan on the basis of the rough figures in paragraph 5.2.2 above for a fall to perhaps 40 per cent of initial value for equities and perhaps 75 per cent of initial value for fixed interest. This would in fact have covered every market fall except that of 1973/74 when equities fell in 1974 to 30 per cent of their value at the peak in 1972. Some would not therefore consider this degree of security sufficient but we suggest that to require any

more would be impractical. It is difficult to say what would happen to property investment in the circumstances envisaged. In the adverse circumstances of 1974 the property market simply ceased to exist and so any valuations were very doubtful and even forced sales were impossible. To assume, however, a possible halving in value from current levels seems reasonably conservative. The "worst case" fall in asset value for our illustrative company would, therefore, be as follows:-

	Current Value	Factor	"worst case" value
	£m		£m
Fixed Interest	88	0.75	66
Equities - U.K	54	0.4	22
- Overseas	10	0.4	4
Property	23	0.5	12
Cash	20	1	20
	195		124

This would completely eliminate the solvency margin even without any adverse experience in other respects.

5.5.3 This example brings out the difficulty of seeking to apply probability distributions to investment values. What is the probability of repetition for something which has happened only once? The data are sparse because old data are not relevant and most of the data are irrelevant anyway because the body of the distribution gives no guide to its tail.

5.5.4 The above assumptions are not particularly stringent. The initial solvency margin of 70 per cent is fairly high and an average, rather than particularly risky, asset distribution has been shown. Furthermore the security margin would not have been quite enough in the worst past circumstances. The degree of gearing in the balance sheet, with underwriting provisions equal to 125 per cent of a year's premiums, is also not especially high. Even so the figures support the assertion that for a typical company the whole current solvency margin is needed to cover possible asset fluctuations alone.

5.5.5 For comparison with the average asset distribution used above, the distributions, from published accounts, for the seven quoted composites as at the end of 1982 are shown below:-

	Commercial Union	Eagle Star*	General Accident*	Royal	Sun Alliance	GRE	Phoenix*
	%	%	%	%	%	%	%
Gilts	46	17	)	33	25	42	35
Other Fixed Interest	23	24	)50	32	11	18	19
Equities - UK & Overseas	15	39	33	23	34	21	21
Property	8	13	12	8	23	13	18
Cash	8	7	5	4	7	6	7
Total	100	100	100	100	100	100	100

*estimates - precise market values not published

Further consideration is given in section 9.8 to the magnitude of the solvency margins which might be required by these companies to cover the risk of asset fluctuation.

5.5.6 Companies are under pressure to take investment risks, since in the long run higher risks have been associated with higher total investment returns. The differences have been high and, for example, over the last 20 years the net equity return for a non-life insurance company has been approximately 10 per cent a year. This compares with a net gilt return of perhaps 2½ per cent a year and retail price inflation of 9½ per cent a year. The policy of having a risky asset distribution would appear, therefore, to have paid off, within the framework of the overall financial management of general insurance companies; the rewards of being in equities have been very large. If pressure had been applied to companies to reduce their investment risk by not investing so heavily in equities, higher premiums would have been required to maintain solvency margins and profitability.

5.6 Further Problems with Investments

5.6.1 The increased use of options, including traded options, and the growth of financial futures offer opportunities for companies to reduce the riskiness of their portfolios. They could also be used, however, significantly to increase the risk level of the portfolio, in the hope of big returns. This could lead to increasing problems for the supervisory authorities. Concentration of investment is another potential problem. The admissibility limits laid down in the asset valuation regulations are helpful in this respect, but a number of holdings in companies or properties whose futures are closely linked may be a potentially more serious problem than is apparent from the raw data, and one which is not tackled at all under the present limits.

5.7 A Practical Solution

5.7.1 The need for capital and other free assets to compensate for investment risk seems on the face of it enormous. In practice some of the effects of significant falls in asset values may be mitigated by changing the balance of portfolios, but it may be difficult to react quickly enough to protect the value of the portfolio. Such an approach may in any case lock in losses and be disadvantageous in the longer term. The main impact of a sudden fall in asset values may also be presentational, as the market may have recovered to some extent before any assets would have to be realised to meet liabilities. Only a prolonged shift in market values would result in the full effects being felt. In the event of a substantial, but temporary fall in market values, the supervisory authorities would be able to give consideration to granting dispensations , rather than closing down large number of companies because they had been unable to meet the requirements on a particular date, although the situation had now been rectified.

5.7.2 We suggest that one major component of minimum solvency margin should be designed to cover the risk of fluctuations in asset values. Such a component should clearly be greatest where the portfolio of assets is most at risk with regard to such fluctuations. It is not likely to be practicable to link the size of this component of minimum solvency margin to detailed formulae for asset risk, but it would be possible to use a formula based on different factors for each of the main categories of asset. For the reasons given in the previous paragraph it may be too stringent to require companies to maintain solvency margins containing a sufficiently large component in respect of asset fluctuations to ensure that the theoretical probability of ruin is as small as would conventionally be acceptable. This chapter has shown, however, the order of magnitude of the parameters which might be involved, and on which a practical compromise might be based.

6. REINSURANCE

6.1 The Need for Reinsurance

6.1.1 An important consideration in relation to the solvency status of a general insurance company is the extent to which reinsurance has been effected, and the nature of the security offered by the reinsurers. One of the major concerns which was identified in respect of valuing the liabilities was the potential variability of the claims settlement process, and the implications for establishing prudent reserves. This is, of course, particularly relevant where there are no limits on the amount for which each claim might be settled. Since the premiums received may relate only to the expected number and level of claims, with a margin for profit and expenses, a significant number of much higher than expected claims, or even just one catastrophically large claim, could easily exhaust the resources of an insurer unless substantial contingency reserves have been set aside.

6.1.2 The insurer's liability will often be limited in the original contract, but to a level which could still prove financially embarrassing if an unusually large number of maximum claims were to arise. A properly constructed reinsurance programme is clearly of central importance in ensuring continued solvency. Without reinsurance a company is potentially very exposed to heavy claims experience, particularly on large risks, and to the effects of accumulation of risks.

6.2 Gross or Net Reserving?

6.2.1 Whilst prudence would certainly require a company to make adequate reinsurance arrangements, the effect of reinsurance on a company's balance sheet solvency will depend on the extent to which it is permitted to take credit for the reinsurance recoveries. In many countries insurers are expected to set up technical reserves in respect of the gross liabilities, even

where some of the liabilities have been ceded to reinsurers. Where reinsurance is on a proportional basis (e.g quota share) it is common in such countries for the reinsurer to deposit his reserves with the ceding office, so that duplication of reserves is avoided.

6.2.2 Under such a reserving system the focus is on the adequacy of the reserves to meet the full gross liabilities. Relatively little weight need be placed on consideration of the security of the reinsurers since reliance is not being placed on reinsurance recoveries. In principle, if this approach is adopted, it could be argued that the margin factors in the assessment of the value of the liabilities, together with the required solvency margin, should be adequate to reflect the potential variability of the gross claims outcome. In practice it is likely to be accepted that reinsurance has some benefit in reducing the variability of the outcome even if specific credit is not taken for the expected level of recoveries from the reinsurers.

6.2.3 The approach adopted in the U.K is quite different, since reinsurance companies operating there are subject to supervision by the authorities on a similar basis to direct insurers. Insurers are allowed to take credit, in establishing their technical reserves, for recoveries expected from reinsurers. In assessing the adequacy of the resulting net technical reserves, regard is had to the security of the reinsurers, in particular to the degree of reliance placed on reinsurance companies which are not supervised by the U.K authorities.

6.2.4. On this approach it would be reasonable to assess the liability margins in relation to the claims experience net of reinsurance recoveries. A well-designed reinsurance programme will have the effect of substantially reducing the potential variability of the run-off of outstanding claims. For a given level of margin factor, therefore, the absolute margin required to allow for variability will be much less if reserves are net of reinsurance recoveries than if they are gross.

6.2.5 To disregard reinsurance recoveries completely seems an unnecessarily crude approach, but to allow for 100 per cent recovery may be thought imprudent. It would be reasonable, therefore, to expect some measure of scaling down of the value of the expected reinsurance recoveries in setting up prudent technical reserves. The extent of this would depend upon the perceived security of the reinsurers concerned, having regard to the possibility of significant failures in the international reinsurance market. On the other hand, variability would be assessed in relation to the net claims experience.

6.2.6 Clearly, if there is doubt about the solvency of a particular reinsurer, caution will need to be exercised in assuming any recoveries from that particular source, in so far, at any rate, as they can be identified. However, the more usual situation will be where management are aware of no specific problem, but where prudence still dictates that some provision should be made against the possibility of default. This is very much akin to the bad debts provision in a bank's balance sheet; it is a general rather than a specific provision, and as a result it must necessarily be somewhat arbitrary, although it can nevertheless be of considerable importance.

6.3 Reinsurance and the Solvency Margin

6.3.1 When it comes to considering the solvency margin which companies should be required to maintain, the attitude towards reinsurance is again of vital importance. If reinsurance recoveries are to be relied upon, as in the paragraph above, the solvency margin would need to have regard to the balance of the potential variability of the net technical reserves. However, whether or not something less than the full 100 per cent recovery is assumed in setting up the technical reserves, the solvency margin should also be considered as available towards shouldering the impact of any significant failure of reinsurance arrangements.

6.3.2 Early OECD proposals for explicit solvency margins (the Campagne report[5]) included a specific addition to the required solvency margin, of 2½ per cent of reinsurance premiums paid, to guard against the risks of failure to recover from reinsurers. The EEC Non-Life Directive partially limits the extent to which reinsurance recoveries can be taken into account in calculating the required margin of solvency, so that net incurred claims cannot be taken as less than 50 per cent of gross incurred claims, but for many companies this is not a significant restriction.

6.3.3 As mentioned above, unless there is good reason to doubt the security of a particular reinsurer, there may be difficulty in agreeing on an appropriate provision for default to be made within the technical reserves. It seems to us, therefore, that some part of the required margin of solvency ought to be defined in terms related to the dependence of the company on reinsurance recoveries. The logical position would be to relate this additional margin to the difference between net technical reserves held and the gross reserves which would have been held (including allowance for variability) if no reinsurance had been effected. Some would argue that an appropriate level of gross reserves would be difficult to establish in some cases, particularly with treaty reinsurance business accepted, and that it would create additional work just for the purposes of calculating the solvency margin. We think it would be surprising, however, if prudent management did not already have regard, even in those circumstances, to the possible exposure in gross terms, when assessing their dependence on retrocessionaries and the possible impact of their failure. The returns under the Insurance Companies Acts require gross outstanding claims estimates to be shown for all classes of business other than treaty reinsurance.

6.3.4 There is no rational basis for deciding on a percentage figure to be applied to the difference between gross and net reserves, but with all the uncertainties of the world reinsurance market, a figure of 5 per cent may not be unreasonable. It could be argued that it should depend on the security offered by the

particular reinsurers used but this would be difficult to operate. A crude alternative would be to reduce the figure to, say, 2½ per cent for reinsurance recoveries anticipated from reinsurers supervised in the U.K. This could present practical problems in distinguishing between recoveries anticipated from different companies in a complicated reinsurance programme and might seem rather arbitrary in giving no advantage to companies reinsuring with major European and North American reinsurers, as opposed to offshore captives and reinsurance bucket shops.

6.3.5 There could be advantages in using the premiums paid to reinsurers as a proxy for the value of recoveries anticipated (as in the OECD proposals) but this approach has significant shortcomings. Firstly, the reinsurance premiums may be inadequate to cover the risks, and may certainly be less than a prudent level of reserves including proper allowance for the variability of gross claims. Secondly, the recoveries anticipated at any balance sheet date cannot be simply related to reinsurance premiums paid in any particular prior period. With a portfolio of business that is running off, reinsurance premiums could be zero, whilst significant recoveries were still anticipated.

7. DISCOUNTING OF LIABILITIES

7.1 The case for discounting

7.1.1 Traditionally, general insurance companies have drawn up their accounts on the basis that premiums are credited and expenses and claims outgo are debited to the accounts, including the cost of setting up of appropriate reserves, resulting in a profit and loss on the "underwriting" activity. The reserves carried forward are, however, of considerable magnitude and can be invested to produce further income (and, possibly, capital appreciation) which contributes to the overall profit of the company. This treatment of investment income as a windfall profit, to be taken credit for only after it has arisen, contrasts strongly with the practice in life assurance, where premiums are set, and reserves established, on the basis of explicit assumptions about the investment return which is expected to be available on the assets held to back the reserves throughout the duration of the contract.

7.1.2 There are, of course, important differences between life assurance reserves and general business liabilities. In the former case, the events which will give rise to claims have not, in general, arisen, and the insurance company will continue to be on risk, for many years, in return for payment of predetermined premiums, (or, in some cases, no further premiums). The events which will give rise to claims are capable of being represented quite adequately by models incorporating probabilities, and , in some cases, stochastic variables, and the amount of claim, when it occurs, is usually predetermined (or related to specific investments). Indeed it is often possible to purchase investments to produce a stream of income and redemption proceeds which will closely match the anticipated outgo under a group of contracts, provided the number of policies is sufficient to produce a reasonably smooth progression of outgoings.

7.1.3 General business liabilities are of a somewhat similar nature in so far as they relate to unearned premiums and unexpired risks, but the largest part of the reserves will often be held for outstanding claims, where the event giving rise to the claim will have already occurred. There may be significant delays in reporting, so that the insurance company will not know, in some cases, that a claim has been incurred. In other cases the claim will have been reported, but the amount will be largely unknown, as will the date of settlement.

7.1.4 Uncertainty about date of settlement is not in practice a problem of any different order of magnitude from modelling the incidence of claims of a life company, since patterns do emerge, which, subject to trends and other perturbations, provide a basis for estimating future rates of settlement. Uncertainty about amount of claim is more of a problem, and it is this factor which, above all, gives rise to the variability in the outcome which has already been discussed in Chapter 4.

7.1.5 In life assurance it is accepted that it would be unreasonable to reserve for the full face value of a payment due in ten years' time, when it is possible to invest, without risk, to produce the required amount at the required time, at a cost significantly less than the face value of the payment. If assets are to be taken at market value, representing in effect the market's assessment of the discounted value of future income and capital proceeds from the assets, it is only reasonable that the amount of future liabilities should be correspondingly discounted, provided that proper care is taken to match the liabilities with appropriate assets, and provided that conservative assumptions are chosen about the terms on which any future investments may be made. Specific mismatching reserves must also be set up where matching falls short of the ideal, either deliberately or unavoidably. Thus future investment income can be taken into account is so far as it is secure, or can prudently be relied upon.

7.1.6 Matching general business liabilities presents greater difficulties, since the amounts of claims are unknown, and indeed, the longer it takes for claims to be settled, the higher might be the amount. Thus the liabilities are, at least partially, dependent on inflation. An appropriate investment policy, therefore, might be based on equities, property and index-linked stock, so as to provide some hedge against the effects of inflation on outstanding claims. However, investment in such assets, particularly equities and property, exposes the office to the possibility of capital depreciation, since assets will need to be sold to meet claims as they arise. Investment in fixed interest securities would permit more satisfactory matching by term, with maturity dates arranged to correspond to the likely incidence of outgo, but there would be no hedge against inflation.

7.1.7 The reality, therefore, is that matching is an elusive concept in relation to general business liabilities, and in reaction to this the normal market practice is to avoid taking any credit for future income from investments. When this arises it will produce a welcome additional profit, but until then it is a contingent asset which should not be taken into account.

7.1.8 Alongside such a prudent approach, one would expect some provision to be made for possible asset depreciation, either by writing down the values of assets in the balance sheet, or by holding a significantly larger solvency margin. Many of the major companies do either or both of these and could withstand quite major movements in asset values without becoming technically insolvent.

7.1.9 An alternative viewpoint might be that it is acceptable to take credit for future investment income, particularly where the average time to settlement is quite long, and reasonably stable patterns of claims settlement are indicated by the past experience. The rate of interest assumed should be conservative in relation to current yields secured on the assets, particularly having regard to the terms on which future disinvestment might be made.

7.2 Is it prudent?

7.2.1 Since the main case for not discounting is the inherent uncertainty of the claims settlement process and the consequent need not to release margins too early, it might be thought imprudent to entertain the possibility of using discounted reserves. However, the issue cannot be considered in isolation. Two other factors at least are of relevance: the assumptions made about future inflation of claims amounts and the allowance made for variability.

7.2.2 At present it is not unusual for reserves, although undiscounted, to make less than fully prudent provision for inflation during the run-off, and include no specific allowance for variability. Thus, in terms of the standard of reserving which was envisaged in Chapter 4, there are significant weaknesses. In these circumstances, it is perhaps as well that discounting is not thought appropriate, as it would produce overall an unacceptably weak standard of technical reserves.

7.2.3 In effect current practice is to offset margins which should really be provided for in the technical reserves against anticipated future investment income. This is not normally done explicitly, and, as a result, the offset is less than satisfactory, although there is probably some correlation between the classes of business which provide the greatest implicit margins from future investment income (because of the build-up of reserves and the long tail of the run-off) and those where margins are needed against fluctuations and inflation.

7.2.4 In our view there are insufficient grounds for forbidding the use of discounting in assessing general business technical reserves, but we consider that it should be permitted only in the context of a proper reserving standard, which requires prudent assumptions to be made about future claims (and expenses) inflation, and an explicit allowance to be made for variability. Without these safeguards, discounted claims reserves would permit the release of profit much too early in the claims settlement process, with a consequential risk that the reserves might later prove inadequate.

7.2.5 We would also argue that implicit discounting, where insufficient margins are set up for inflation and variability, can be imprudent, even if reserves are not discounted, and that these elements should be fully taken into account, whether or not the reserves are subsequently discounted. If discounting is not applied, the resulting reserves will contain significant margins. If it is used, and used prudently, the reserves will still be adequate.

7.2.6 Since additions to technical reserves may be made out of operating surplus before it is subjected to tax, the appropriate guideline for investment return is the gross rate of interest receivable on the assets. This would be reduced to allow for any high risk content in the yields on the existing assets, and further reduced to take account of the fact that it would be imprudent to assume that any reinvestment of income could be made on the same terms as have already been secured on the present portfolio. Further margins could be taken if desired by assuming a lower valuation rate of interest than could be justified on the above criteria.

7.3 Accounting implications for discounted claims reseres

7.3.1 We must also consider the compatibility of discounting claims reserves with fundamental accounting concepts. Clearly, it is consistent with the going concern concept and, provided it is employed in every accounting period in the same way, it is compatible with the consistency concept. The accruals concept, however, presents rather more of a problem, since the cost of a claim should, by the matching principle, be charged in the same accounting period as that in which the premium is earned. If we discount our claims reserves, then part of the cost will be spread into later years. However, the argument is that this will match investment income generated from the assets representing the reserves. If investment income is explicitly taken into account in setting the premium rates then perhaps it can be argued that discounting is consistent with the accruals concept.

7.3.2 The concept of prudence requires that future revenue is not anticipated but that all known liabilities are provided for. In this case, we are providing for less than we expect our eventual liability to be, the shortfall being represented by the future investment income we expect to obtain. This would appear to be contrary to the concept of prudence. However SSAP 2 states that accounting concepts, bases and principles are intended to provide an orderly and consistent framework and not to be a substitute for commercial judgement. The longer the period between the initiation of business transactions and their completion, the greater the area subject to judgement and the less the susceptibility to close regulation by accounting bases. Since the claims reserves which are discounted are likely to be those where there is a substantial delay to settlement, it is possible to use this as justification for not complying entirely with the concept of prudence. The approach would, of course, be consistent with that used by life offices, where it is accepted as perfectly proper and prudent.

7.3.3 It is also interesting to note that the Sandilands report explored the possibility of companies generally including assets at current values in their balance sheets, with liabilities being also included at current value. They concluded that current methodology did not permit this but pointed to life offices as examples of companies who do include the current value of their liabilities at present. It can be argued that the inclusion of assets at market value is the equivalent of including them at replacement cost; we could then argue that we should include the current value of our liabilities, by discounting them in the same manner as life offices do.

7.3.4 Under a system of discounting claims reserves, the amount held in respect of each underwriting year will, apart from the effect of claims payments actually made, increase each year in line with the assumed rate of return (unless the valuation basis is changed). Investment income in excess of the assumed rate

falls into profit, whilst any shortfall would produce a loss, although in principle one would expect this circumstance to be rare if a prudent assumption has been made. However, profits and losses relative to the valuation basis can also occur as a result of variation in the speed of settlement, depending on whether a positive or negative real rate of return (net of claims inflation) is being assumed.

7.3.5 Abbott et al[6] have shown the value of using discounted claims reserves from the standpoint of giving a true and fair view of a general insurance company's affairs. We agree that the approach has a lot to commend it from this point of view and believe it to be consistent with prudent reserving standards, provided, as already indicated above, that it is done on the basis of an explicit model with prudent assumptions in respect of all the relevant factors, including the rate of inflation and the allowance for variability.

8. THE SCOPE FOR AN ACCOUNTING STANDARD

8.1 Background to Accounting Standards

8.1.1 The introduction of accounting standards in the UK may be traced to the issue of the 'Statement of Intent on Accounting Standards in the 1970's' by the Institute of Chartered Accountants in January 1970, and the establishment later that year of the Accounting Standards Steering Committee. Although non-mandatory guidelines had been issued since the early 1940's, matters were brought to a head by a series of happenings in the late 1960's, including the Rolls Razor, GEC/AEI and Leasco/Pergamon affairs. These crises led many accountants to fear government intervention and the Steering Committee was seen as a demonstration that the profession was able to put its own house in order.

8.1.2 The Statement of Intent had four major objectives: the narrowing of differences in the variety of accounting principles, the disclosure of accounting bases, the disclosure of departures from established definitive standards and the wider exposure of major new proposals. The first standard was promulgated in 1971 and there are now seventeen in force, plus five others where proposals have been issued as exposure drafts.

8.1.3 The acceptance of the Committee's proposals was initially straightforward, possibly because many of them dealt with subjects which were related to the crises which brought the Committee into existence. Later proposals have sometimes been more problematic. Criticism of the original standard on deferred taxation required it to be withdrawn and replaced. Difficulties with the treatment of investment properties delayed the implementation of the depreciation standard. The problems experienced with inflation accounting are too well known to require repetition here.

8.1.4 The subject matter of standards has been usefully summarized by Edey[7]. He distinguishes four types as follows:

Type 1, which stipulates that accountants must tell what they are doing. The obvious example of this is SSAP 2, which requires the disclosure of accounting policies.

Type 2, which aims at uniformity of layout and presentation. Such standards are rarely issued in the UK or USA but are common in continental Europe. The Accounts and Statements Regulations for insurance companies may be regarded as an example of this type of standard although not one laid down by the profession.

Type 3, which calls for disclosure of specific items, particularly where the reader ought to exercise his own judgement. Examples might be extraordinary items or research and development expenditure. It should be noted however that such standards still require the exercise of judgement in deciding whether a specific item comes within the scope of the standard.

Type 4, which deals with income measurement and the valuation of assets and liabilities. Such standards specify which methods of accounting are regarded as 'correct'. Examples are those relating to deferred tax and foreign currency translation. Any accounting standard for the insurance industry would presumably come within this heading, in so far as it stipulated methods of determining profit and the values of assets and liabilities.

8.2 The Problem with Accounting Standards

8.2.1 It has been argued that any standard may become petrified and thus impede progress. The essence of any profession is

that its members are able to think and judge for themselves on matters of principle. Accounting standards may enable accountants to abdicate such responsibility in favour of a ready-made code.

8.2.2 Accounting figures do not always lend themselves to standardization. Industries differ, as do firms within an industry. The same firm may change from year to year and the needs of users may vary. Standards aimed at the 'average' firm may be quite unsuitable for the fringes. Furthermore, the wording of standards will inevitably give rise to difficulties of interpretation. This may result in concentration on hair-splitting rather than important issues.

8.2.3 However, since the results of one company can be assessed only by comparing them with those of other companies, users of financial statements are entitled to expect that the statements are comparable. It is unrealistic to imagine that users have the time, ability and, in particular, the information to adjust the results of different companies to a common basis.

8.2.4 To assess the results of an individual company over a period of time, the results must be prepared on a consistent basis if the trend they display is to be meaningful. Further, the value of the auditors' report is undermined if companies may manipulate results simply by choosing different accounting policies.

8.2.5 The consultative processes by which accounting standards are developed compel accountants and other users of financial statements to rethink and justify what they are trying to achieve. This should lead to a better understanding of the nature of accounting and a consequent gain in effectiveness. Many accounting standards are the by-product of good management accounting systems. The same principles are applicable for both internal and external reporting. Thus, the development of accounting standards should improve both financial statements for external users and the quality of information for managers.

8.2.6 Inevitably, the standard setting process is a political and social one, in which interest groups may attempt to use what power they possess to influence the outcome and to preserve the status quo. Thus, a new standard is not lightly to be embarked upon, unless there is a groundswell of opinion that it is needed or a threat of government regulation otherwise. In our view the need for standards in the area of general business reserving is sufficiently important that if accountants and actuaries do not grasp the nettle, sooner or later rules will be imposed by statutory regulation.

8.3 Scope of a Possible Standard

8.3.1 The scope of a possible accounting standard for general insurance companies must now be considered. Firstly, the relationship to existing, general standards must be decided. Present standards relate almost entirely to factors which are common to all industries and it seems reasonable to propose that any specific insurance standard would operate within this framework. Thus, for matters such as group accounts, deferred taxation, translation of foreign currencies etc., the prevailing standards would apply. The specific standard would cover only those aspects particular to general insurance companies.

8.3.2 The context of this report has been that of demonstrating solvency to supervisory authorities and other third parties. The principal vehicle for this is the returns submitted under the Insurance Company Acts. Although these are governed by regulation, we have already noted that no rules are prescribed for valuing general business liabilities except the application of generally accepted accounting principles. This would provide a statutory link to the returns if an accounting standard were to be agreed, although such a standard would clearly apply also to accounts prepared under the Companies Acts.

8.4 Asset Valuation

8.4.1 It is for consideration as to how far a standard might go in laying down rules for the treatment of assets. The Insurance

Companies Regulations 1981 already prescribe methods of valuing a number of types of asset, but this does not prevent a company from using other methods for the purposes of Companies Act accounts. An obvious issue is whether an accounting standard might apply the statutory asset valuation rules to ordinary insurance company accounts, but this might be held to conflict with the requirement to demonstrate a "true and fair view". The regulations impose limitations on the extent to which certain assets may be taken into account and although these are designed to produce a prudent valuation of the assets, they might in some cases go further in this direction than would be compatible with showing a true and fair view. It seems probable, therefore, that the scope of the possible standard in relation to assets would stop well short of the full asset valuation regulations, although it should in principle be compatible with the approach in the regulations. It could in other respects go further than the regulations, e.g. in discouraging deliberate undervaluation of assets such as property and in giving guidance on such matters as valuing debts not due within the next twelve months.

8.4.2 We have given some consideration to whether an accounting standard might require assets to be valued at less than their current market value, since it could be argued that it is imprudent to place a value on the assets which may not be capable of realization at the time the assets come to be sold. This notwithstanding, it seems to us unlikely that a satisfactory basis could be found for adjusting market values in respect of this factor, or that there would be general acceptance of the principle that listed investments, in particular, should be shown at other than their current market value. Our conclusion was that no adjustment should be made to the asset values, but that appropriate provision should be required to be made for the asset depreciation factor as part of the solvency margin.

8.5 Valuation of Liabilities

8.5.1 It is in respect of the valuation of general business liabilities that we can see the greatest need for an accounting

standard as a basis for a consistent and prudent approach. The absence of any standard, or of any statutory rules, throws into question the validity of measuring a company's declared solvency margin against a clearly prescribed minimum. We consider that an appropriate standard could be of assistance in overcoming some of the present shortcomings of the system, although it cannot be ruled out that some statutory rules may in the end prove necessary.

8.5.2 The first decision which must be made is whether a retrospective valuation of liabilities is to be permitted or whether prospective valuation will be insisted upon. In other words, under what conditions will three year accounting and its variants be permitted? Some of the questions to be considered are:

(i) Should the circumstances in which it is to be permitted be strictly defined?

(ii) Would its use be mandatory or optional?

(iii) At what intervals would the adequacy of the fund have to be assessed?

(iv) Should the method of assessing the adequacy of the fund be laid down?

(v) What disclosures would be required regarding the adequacy of the fund?

8.5.3 For one year accounting, consideration would need to be given to the appropriate level of unexpired risks reserve. Matters to be covered might include:

(a) What bases are acceptable for calculating unearned premiums? What disclosure about the computation will be required?

(b) What factors should be taken into account in assessing whether any additional provision for unexpired risks is required? Should a loss ratio be assumed which is prudent in relation to recent experience and includes a margin against the potential variance in the ratio? What disclosure requirements should there be?

(c) How should deferred acquisition costs be dealt with? Should they be netted against unearned premiums or shown gross? What details of the calculation should be shown?

8.5.4 The range of factors which might be covered is quite wide, but perhaps the most important issues, for our purposes, arise in connection with the estimation of outstanding claims reserves (although some similar points are relevant to consideration of the unexpired risk reserve at 8.5.3(b) above). Some of the issues to be addressed would be:

(a) The method of estimation to be used. Should case estimation be permitted and, if so, should the results be checked by statistical methods? What statistical methods should be permitted or should complete freedom of choice be left to the Company? What disclosure of the assumptions underlying statistical methods should be required?

(b) The degree of conservatism in estimation. Should full provision for the estimated future cost of claims be required? What provision should be required for future inflation, and what should be disclosed about the assumptions made in this respect? What margin of safety for variability above the mean estimate should be required? What disclosure should be required in relation to the margins?

(c) Claims incurred but not reported. What methods should be stipulated or permitted for IBNRs? What disclosures relating to IBNRs and their calculations should be required?

(d) Discounting. Under what circumstances should discounting be permitted? What constraints should there be on the assumptions employed? What disclosures should be required about the assumptions made in discounting?

8.5.5 There are a number of further matters which might be covered by an accounting standard, in particular in relation to the treatment of certain items of income and expenditure for the purposes of demonstrating operating profit. Although we gave some consideration to this, it is not directly relevant to the subject matter of this report.

8.5.6 The scope of an accounting standard for general insurance companies could be very wide, or it could be restricted to certain key aspects. Our principal concern in relation to solvency has been with the adequacy of the provision made for outstanding claims and unexpired risks. We are convinced that minimum standards are needed in this area, because of the uncertainty which exists at present over what constitute generally accepted accounting concepts, bases and policies and what methods are generally accepted as appropriate for insurance companies (regulation 52 of the Insurance Companies Regulations 1981). If the professions cannot agree on an adequate standard it is more than likely that the supervisory authorities will in due course legislate in this area, and such a solution would be much less flexible.

8.5.7 As a minimum we would want to see a requirement that reserves should normally be tested by statistical methods, that they should include prudent allowance for inflation (including "social" inflation, e.g. of court awards) and a margin of at least 1½ standard deviations above the mean estimate, and that where discounting is practised it should be on prudent assumptions. Furthermore, there should be full disclosure of methods and bases used.

9. THE SOLVENCY MARGIN

9.1 The role of the solvency margin

9.1.1 It remains to be considered what level of minimum solvency margin would be appropriate, on the assumption that technical reserves could be relied upon to meet the standards outlined in the previous chapter. As explained at the beginning of this report, we see the solvency margin as providing a contingency reserve to meet the more extreme possible variability in both assets and liabilities, as well as providing a buffer to enable corrective action to be taken by the supervisory authority before a real state of insolvency is reached.

9.1.2 In practice, with the standard of technical reserves we are advocating, it should still be possible to run off the business satisfactorily, even when the solvency margin has disappeared, in perhaps 9 out of 10 cases. This, we believe, is how it should be. Technical reserves which only stand a 50 per cent chance of being sufficient to run off the liabilities can hardly be considered adequate.

9.2 The components of the solvency margin

9.2.1 We suggest that the solvency margin should be built up out of five independently calculated components. These would relate to the following risks:

(a) Asset depreciation
(b) Extreme fluctuations in the claims run-off
(c) Reinsurance failure
(d) Underwriting risks
(e) Other unquantifiable risks

We consider each of these in turn.

9.3 Asset depreciation

9.3.1 The dangers to a general insurance company of sudden depreciation in the realizable value of the assets held have been considered in Chapter 5. It is, of course, essential that the assets should not be overvalued, but the asset valuation regulations, which apply to returns under the Insurance Companies Acts, largely prevent this. We do not consider it feasible to require further margins to be taken in the value placed upon the assets in the balance sheet, but one component of the solvency margin should be designed to give protection against possible falls in the value of assets which cannot be offset by any reduction in the liabilities. Where the fall in asset values results from a general rise in interest rates, which could be reflected in a higher, but still prudent, discount rate, or where changes in market values reflect expectations of lower inflation, which could also imply a need for lower technical reserves, the full strain will not fall on the solvency margin.

9.3.2 The degree of risk is clearly dependent upon the assets held and the relevant part of the solvency margin should be built up of a series of components. The considerations in Chapter 5 would tend to suggest fairly substantial factors to be applied to the value of assets held to back the technical reserves, particularly in respect of equities and property, if not improbable falls in asset values are not to leave the technical reserves uncovered. For example, the figures in paragraph 5.2.2 would point to a solvency margin based on the following percentages of the assets:

Fixed interest	25%
Equities	60%
Property	50%

In Chapter 5 these figures were suggested as being applied to the total assets held including the solvency margin. In practice companies will normally have a solvency margin in excess of the required level, and there seems no need to require any additional

solvency margin in respect of the excess assets, whatever they may be. The factors should, therefore, be applied to the total assets covering the technical reserves and the required margin of solvency. Since these assets are not identified as such, the total assets would have to be rated down proportionately.

9.3.3 We believe that it might be difficult to gain general acceptance for an asset component of the solvency margin of this magnitude, and there are, in any case, factors which suggest that it would be unduly stringent (see paragraph 5.7.1). It would certainly put pressure on companies not to invest in equities and property, which could be regarded as being in the long term interests of policyholders from the point of view of improving investment return, hedging against inflation, and hence keeping premium levels down. There will also, as described above in paragraph 9.2.2, sometimes be an offsetting reduction that can be made in the liabilities.

9.3.4 We recommend, therefore, that the asset depreciation component of the solvency margin should be based on somewhat lower percentages of total assets held. For the sake of illustration we have used factors approximately equal to half those given above:

Fixed interest	10%
Equities	30%
Property	25%

In practice different factors might be appropriate at different times, depending on market levels at the time.

9.4 Claims fluctuation

9.4.1 We have suggested in the previous chapter that technical reserves should incorporate a margin for variability in the run-off of outstanding claims equivalent to 1½ standard

deviations over the mean. A reasonable criterion for the solvency margin component intended to cover this aspect might be that it increased the total provision to 3 standard deviations above the mean. As indicated in Chapter 4, it would in many ways be preferable to express this level of overall security in terms of a probability of ruin. On the basis of a normal distribution the criterion of 3 standard deviations above the mean is equivalent to a probability of ruin of just over 1/1000.

9.4.2 It would be difficult in practice to have a solvency margin requirement which depended on characteristics of the claims distribution for a particular company and risk group. However, some reflection of the differing variability of different classes of business seems essential. The most practicable option appears to be to establish factors by accounting classes, based on an average of the ratio:

$$\frac{1\frac{1}{2}\ 6}{\mu + 1\frac{1}{2}\ 6}$$

These would be applied to the outstanding claims reserves for respective accounting classes. The calculations we have carried out (see tables in Appendix 5) suggest that the following percentage factors might be appropriate:

Accounting class		%
1	Accident and Health	19
2	Motor Vehicle	10
6	Property Damage	13
7	General Liability	14
8	Pecuniary Loss	18

Further work needs to be carried out to indicate appropriate factors for MAT and Treaty Reinsurance business, but for the sake of illustration we have assumed that the variability of the run-off for these classes might be somewhat greater and have taken the factors to be 20%.

9.5 Reinsurance failure

9.5.1 In Chapter 6 we outlined the issues in relation to taking credit for reinsurance recoveries and concluded that it is not unreasonable for credit to be taken for reinsurance recoveries, and for variability to be measured in relation to the net run-off, although consideration should still be given to the need for a general provision in the technical reserves against the risk of reinsurance failure. However, whether or not such a provision is made, the required margin of solvency should contain a specific component to cover this risk.

9.5.2 We are not aware of any way in which this risk can be quantified, and it is probably not feasible to relate it to any perceived level of security of individual reinsurers. The only practicable solution seems to be to require a solvency margin based on an arbitrary percentage of the total recoveries expected from reinsurers, with possibly some crude differentiation between reinsurers whose operations are subject to control by the supervisory authority (or by another acceptable authority). For the purposes of illustration we have used a factor of 2½%, although a higher factor might be appropriate where there is a preponderance of unsupervised reinsurers.

9.6 Underwriting risks

9.6.1 Whilst the previous three factors relate to the reliability of the position shown in the balance sheet as a representation of the ability of the company to meet its existing liabilities from its existing resources, this and the next section concern adverse financial circumstances which may result from continuing to write further new business. As explained in paragraph 2.4.6, the statutory solvency margin must be sufficient to provide a buffer against the effects of continuing to write business for at least a further 18 months or so. If premium rates are inadequate, because of higher claims frequency than usual, higher than expected claim amounts, inflation, large claims, development of the insurance cycle, inadequate loadings,

etc, this can result in operating losses which could quickly erode the solvency margin demonstrated at the last balance sheet date.

9.6.2 Consideration of the potential impact of these risks on the company, and an assessment of a realistic level of solvency margin to provide the required degree of protection, is a complete subject in itself. We have already noted that this aspect is central to the Finnish study[1] (see also Appendix 1) and we believe that something along similar lines will be needed in the UK context in order to complete the analysis which this report has started.

9.6.3 Without carrying out the necessary work, we can do no more than guess at the appropriate size of solvency margin component to cover these risks. From the results of the Finnish study one would expect appropriate factors to provide against an 18 months delay to lie generally in the range 30 to 50% of earned premiums. These certainly seem high and could not be applied uncritically to the UK situation without more research. However, for the purposes of arriving at an overall assessment of minimum solvency margin based on the factors considered in this report, we have taken a component of 15% of earned premiums for the underwriting risks.

9.7 Other risks

9.7.1 There are many other potential risks to which a general insurance operation is subject. Experience has shown that problems can easily arise from poor management, failure to control expenses, fraud, etc. Such risks are unquantifiable, both as regards incidence and financial impact, but the solvency margin should be capable of withstanding them to some degree. The appropriate solvency margin component is inevitably a matter of judgement and there is some overlap with the previous item. A fixed component might be thought suitable in some respects, giving a minimum level of solvency margin even for the smaller company. If this were to be set at, let us say, £200,000, a

further component might be incorporated, which could be related to the size of the company's operation by expressing it as a percentage of the management expenses in the previous year. We suggest 50% might give the right level of protection, bearing in mind the other elements of the solvency margin, and the expectation that some provision for the overrun of management expenses on closure to new business would have been made as part of the technical reserves.

9.8 Summary

9.8.1 The combination of these five components of solvency margin might be thought by some to produce an unnecessarily high level of security and be ultimately detrimental to policyholders because of the implications for financing the necessary capital. We have examined the possible impact on a selection of the larger companies, making a number of assumptions where necessary. The results as at 31 December 1981 are shown in Table 1.

9.8.2 The table shows the importance of the asset depreciation element of the suggested margin of solvency, particularly for such companies as Sun Alliance and Eagle Star with a relatively high proportion of their assets in equities. With the run-off fluctuation item it must be borne in mind that the technical reserves may currently be at a stronger level than that suggested in Chapter 8 as the standard, so that some reserves might be able to be released if this solvency margin requirement had to be met. The reinsurance element is not significant in the context of these large companies, although it could be so for many smaller companies in the market.

9.8.3 Most of the companies examined above would have been able to meet the suggested standard as at 31 December 1981 without weakening their technical reserves. The situation at the end of 1982 would in most cases look better, principally because of asset appreciation during 1982. This highlights the question of whether different asset depreciation factors might be appropriate at different times. The introduction of the life solvency margin

TABLE 1 Required margin of solvency (as % of earned premiums)

Company	Asset depreciation	Fluctuations in run-off	Reinsurance failure	Underwriting risks	Other risks	Total	Declared margin of solvency
Commercial Union	22.7	11.8	0.7	15.0	12.7	62.9	75.2
Cooperative	27.6	8.1	0.1	15.0	13.8	64.5	63.2
Cornhill	28.1	8.4	0.3	15.0	12.3	64.1	54.9
Eagle Star	34.6	17.8	0.8	15.0	13.0	81.2	77.6
General Accident	24.7	10.1	0.1	15.0	10.6	60.6	83.4
Guardian	14.0	12.8	0.3	15.0	10.0	52.1	103.9
Legal & General	25.0	12.0	0.4	15.0	13.5	65.8	54.6
National Farmers	22.9	8.4	0.1	15.0	8.9	68.3	134.9
Phoenix	17.4	16.9	1.0	15.0	8.5	58.9	76.8
Prudential	16.6	8.9	0.3	15.0	13.2	54.0	56.6
Royal	19.1	10.7	0.3	15.0	10.0	55.1	103.3
Sun Alliance	37.8	15.5	0.6	15.0	13.5	82.5	99.1

The introduction of the long-term business solvency margin on 15 March 1984 will reduce the free assets available to meet the general business solvency margin.

on 15 March 1984 will, for these and some other companies, reduce the level of free assets available to cover the suggested general business solvency margin, either directly, or by decreasing the value that can be placed on life subsidiaries.

9.8.4 Examination of a small and non-representative sample of less well-established companies suggests that the asset depreciation element might be of considerably less importance to some companies (several produced solvency margins of around 7% of earned premiums for this item), whereas the claims run-off fluctuation and reinsurance failure elements can attain a much greater significance. Some companies would need a fluctuation element of 40% of earned premiums or more (where, for example, there is a preponderance of long-tailed business), whilst the reinsurance element can rise to 7% or more, even without imposing any higher level of margin in respect of reinsurance with non-supervised reinsurers. The range of total required solvency margin for the sample investigated was from 38 to 83% of earned premiums.

9.9 Conclusion

9.9.1 Although we began this report by limiting our sights to short-term solvency as viewed by the supervisory authorities, our conclusions suggests that companies' own horizons do not go very much beyond this and that the free asset position of most companies contains little more than the basic provisions against the risks of continuing to write business for the next 18 months or so which we postulated as being appropriate for a company to be permitted so to continue.

9.9.2 Our suggestions point to solvency margin requirements considerably greater than those laid down in the EEC Non-Life Establishment Directive, although more sensitive to the particular circumstances of individual companies and, therefore, in our view more capable of rational justification. We envisage also that a prudent standard for technical reserves would form the basis for assessing the solvency margin available. There is a degree of arbitrariness in the way we have reduced the asset

fluctuation factors by 50% and in the specific size of the factors we have introduced for reinsurance failure and for underwriting and other risks. However, whilst there is room for discussion over the exact level of the parameters, we do not think that the values we have taken for illustrative purposes are unreasonable.

9.9.3 There is scope for more research into methods of allowing for the variability of the claims run-off and a simulation exercise along the lines of the Finnish study could provide a more satisfactory basis for the underwriting risks factor.

9.9.4 The topic of solvency is wide-ranging and extremely complex and is not susceptible to neat mathematical solutions. We have attempted to temper theory with pragmatism and have put forward our ideas to encourage further discussion in the profession, in the hope that a coherent view might emerge.

Chris Daykin
Russell Devitt
Rafi Khan
Jim McCaughan

September 1983

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APPENDIX 1

REVIEW OF THE FINNISH STUDY

1 Background

1.1 The report "Solvency of Insurers and Equalization Reserves" by Pentikäinen and Rantala[1] was published in English in 1982 to present the results of a comprehensive study into the factors affecting the solvency of general insurance companies. It is of particular interest because of its use of model-building techniques based on the concepts of risk theory and for its use of simulation methods and the graphical representation of the results as "stochastic bundles".

1.2 The starting point for the report was an analysis of the past experience of the Finnish insurance market, from which information about the nature of the underlying underwriting cycles and the parameters of the various stochastic models were derived. The context was that of the Finnish system of equalization reserves, which was introduced by their 1953 Insurance Company Act. Similar provisions exist in German and Swedish legislation. These provide for a specific reserve to be set up in addition to normal technical reserves, with the object of providing a buffer against variability in the underwriting experience.

1.3 The 1953 Finnish legislation lays down a minimum standard in respect of working capital, which comprises equity capital and undervaluation of assets (effectively the difference between historic book values and current market values). This standard is expressed as:

$$A = \begin{cases} 0.2 + 0.2\,B & \text{for } B < 4 \text{ million Finnish Marks} \\ 0.6 + 0.1\,B & \text{for } B \geq 4 \text{ million Finnish Marks} \end{cases}$$

where A is the minimum working capital
and B is earned premium income.

This two stage formula was based on a parabolic curve $U = a\sqrt{B}$, which emerged originally as a first approximation to the minimum capital required on simple risk-theoretical grounds, taking into account observed risk fluctuations, and was subsequently applied, in the above form, as an appropriate level of buffer against risks of a non-stochastic nature.

1.4 In addition, however, there is a statutory obligation for insurers to maintain a minimum level of solvency, when equalization reserves are also taken into account, as well as working capital. This is expressed in quite general terms in the legislation:

> "An insurance company shall, by reinsurance or otherwise, carry on its business in such a manner that a sound relationship, safeguarding the insured interests, is created between the probable fluctuation of the claims expenditure and the working capital."

On the basis of this a solvency test was devised and insurance companies have had to demonstrate each year that the minimum test, which involved a risk theory evaluation, was satisfied.

1.5 One of the objects of the 1982 Report was to examine the suitability of the rather crude 1953 solvency test and to suggest a reformulation. As a result the Ministry of Social Affairs and Health have now promulgated a new minimum solvency standard, which requires, in addition to the minimum working capital, a minimum level of equalization reserve as follows:

$$U_{min} = 0.214 \sum P - 0.043 \sum B + \sqrt{(7.92 \sum \beta MP + 9.2 \sum 6^2 P^2) + M + U_C - A}$$

where P = net risk premiums earned in class j

B = net premiums earned in class j

β = constants indicating the degree of heterogeneity of the portfolio

6 = standard deviations of the short-term variations in the risk intensities

M = maximum net retentions per risk unit in class j

U_C = catastrophe reserve for foreign reinsurance business accepted

A = minimum working capital

This formula can be evaluated in the circumstances of any individual company using standard tables for the parameters β and 6 by class of business. It is designed to give a level of security from the effects of stochastic variations equivalent to a risk of ruin of not more than 1/100 with a time span of one year.

1.6 The equalization reserve forms part of the technical reserves, although it is a major element meeting the minimum solvency requirement. This is made clear in the following definition in the Insurance Company Act:

> "The claims reserve is equivalent to the amount of incurred but outstanding claims and other expenditures related thereto and includes an amount of equalization, calculated according to risk theory, to provide for years with a high loss frequency."

Transfers to the equalization reserve may be made out of pre-tax profits, although the rate of transfer is controlled by certain rules, which depend on whether the present equalization reserve is within the "target zone" $[U_1,U_2]$ or not ($U_{min}<U_1<U_2<U_{max}$). The maximum level of equalization reserve permitted is determined by further formulae, designed to provide for a risk of ruin of 1/100 in the longer term (say, over 10 years or more) taking into account inflation, underwriting cycles, claims variability, growth of business, etc.

1.7 Although described as a technical reserve, there is little doubt that the equalization reserve concept goes well beyond what would normally be regarded as covered by technical reserves in the UK. The working capital requirement, on the other hand, is low compared with the EEC solvency margin, amounting to something of the order of 10 per cent of earned premiums for large companies, and rather more for smaller companies. The minimum solvency requirement varies greatly between companies in terms of earned premiums, but appears to lie generally in the range 20-40%. The maximum permissible equalization reserve varies even more but in the majority of cases lies between 100 and 150% of earned premiums.

2 The Nature of the Study

2.1 The Finnish research group started by collecting empirical data and analysing them to form a view of the fluctuations in the various risks to solvency and estimates of the maximum possible losses these risks could cause. A theoretical model was then constructed, the parameters of which were estimated from the empirical data.

2.2 The core of the study was an investigation into the impact on a company's solvency of the business which might be written in future. For the purposes of determining the minimum solvency margin this was done with a one-year time horizon, whereas for the maximum equalization reserve the position in the longer time was examined. Regard was had to stochastic

variation in claim number and claim size, the effect of superimposing underwriting cycles, the impact of inflation, both steady and with sudden changes, real growth in the volume of business written, the effect of catastrophes and large claims, etc.

2.3 The above approach contrasts markedly with that adopted in the present report, where attention has been focussed on the margins needed in the balance sheet at a particular point of time, in order to cater for the inherent uncertainty of the estimates used for technical reserves and for the changes which might take place thereafter, eg in the value of assets which might upset the position as demonstrated. In particular, we have been concerned about the estimation of reserves for outstanding claims and the need to provide in full for what they might turn out to be, with a low probability of their proving inadequate. The Finnish report ignores any uncertainty that may exist in the reserve for outstanding claims and we have not been able to find any clue in the report as to the basis on which outstanding claims are assessed. It seems probable that any adverse variation in the outcome is intended to be covered by the minimum working capital requirement and that this particular risk is regarded as coming under the heading of inadequacy of accounting systems, within the subsidiary non-stochastic risks category.

2.4 Furthermore, there is no consideration of the risk of falls in asset values. Since assets are shown in the accounts at book value, there may already be a substantial margin taken in the value of the assets that are shown as held against the technical reserves. There may also be less variability in the type of assets held in Finland than would be the case with the assets of a UK insurer. The undervaluation of assets is, however, counted towards the minimum working capital requirement. Thus, the effect of a fall in asset values would

be to use up part of the working capital, rather than to uncover the technical reserves, unless the values fell to below book values. The Finnish report does not appear to consider this very likely.

2.5 It can be seen, therefore, that the preoccupations of our report are very different from those of the Finnish study, and that the factors on which they have concentrated are those which we have classed under miscellaneous non-quantifiable risks of continuing to write business. The principal lesson which we can learn from the Finnish report is that much can be done to quantify the effects of future losses from continuing to write business and that more work ought certainly to be carried out in the UK in relation to this aspect in order to round off a coherent proposal for minimum solvency requirements. We have done no more on this aspect of solvency than to suggest a component of the solvency margin based on the volume of premiums written, having some regard to the size of margin indicated by the Finnish study as being necessary.

3 Empirical Analysis - Variability and Cycles

3.1 The loss ratios and the amounts of the equalization reserve relative to earned premiums were collected for all Finnish non-life insurance companies for the years 1962-1978 inclusive. The companies were divided into three categories: specialist insurers, specialist reinsurers, and general companies. Attention was restricted to the last group, because of the small size of the other two groups. Examination of the data suggested that it was subject to fluctuation of at least four types: random fluctuation, short term variation in the basic parameters, cyclical variation in the basic parameters and secular trends.

3.2 The relatively small size of the Finnish market meant that it was possible for the study to encompass the whole market. A study of UK companies would presumably have to be

restricted to a sample, rather than covering the total population. Data would presumably be available only from 1970, the first year for which returns were made to the DoT under the 1968 Regulations, and some of the earlier years might not be as reliable as might be desired. Indeed, an analysis which properly related incurred claims to the earned premiums giving rise to them will be possible only for 1981 and later years, since earlier years' returns did not separate out adjustments in respect of prior years.

3.3 The total business of all Finnish companies was then aggregated, to eliminate random fluctuations, and the results for each class of business were smoothed, by the use of moving averages, so that the resulting curves reflected predominantly the long term cycles. For the classes which comprise the bulk of the business written by the Finnish companies, clear long term cycles were shown. There was a high degree of correlation between these cycles and a number of economic indicators. It would be necessary to investigate whether the UK data indicates a similar feature.

3.4 What little research has been undertaken into long term business cycles and insurance suggests a correlation between insurance cycles and cycles in the economy as a whole. Such cycles must be introduced into any simulation model, in order to make it realistic. Indeed, they were a very important factor in producing the high solvency margins in the Finnish study. They do not have to be forecast accurately; it is sufficient to assume that cycles such as those which have occurred will occur again. Insurers must be capable of withstanding such adverse movements when they occur. The Finnish group made certain working hypotheses about these cycles based on past experience in their market. A UK study would have to develop appropriate hypotheses in a UK context, as this is likely to be critical to the overall level of solvency margin needed.

4 Empirical Analysis - Inflation and Growth

4.1 Inflation affects insurance companies in many different ways. To introduce the appropriate time-lags, a distinction was drawn between premium inflation and claim inflation. It is conventionally argued that inflation is correlated with general economic booms and recessions. Although this is not invariably so, it is, for solvency purposes, a conservative assumption. Different parts of a company's portfolio are affected to different degrees by inflation but it was considered better, on balance, to have a single joint time-dependent rate of inflation, to prevent the model from becoming unwieldy. Currency risks are also related to national and international rates of inflation.

4.2 A UK study would have to examine whether the assumed correlation between general economic performance and inflation is appropriate in a UK context. A single inflation rate might not be considered appropriate. Currency risks are presumably more important to UK companies and would therefore merit more attention.

4.3 The Finnish group conducted some research that suggested that the growth in the premium volume of non-life insurers was related to the growth in GNP. Although some other economic indicators explained the premium growth for certain classes better, GNP was considered to be the best explanatory variable overall. This conclusion would certainly require investigation in the UK context, particularly because of the greater international involvement of UK insurers.

5 Empirical Analysis - Catastrophes and Other Risks

5.1 Special risks concerned with international business have to be taken into account, especially catastrophically large claims which the international reinsurance system may channel in a way which is difficult to predict. Premium rates tend to fall to inadequate levels if no major disasters occur for some time in an area which is sensitive to catastrophes. The Finnish group considered the chance of super catastrophes realistic enough to be taken into account. Presumably the same would be true for a UK study.

5.2 In addition to underwriting risks, insurers are subject to other subsidiary risks, including political risks, management risks, reinsurance, problems with new insurance products, computers, inadequacy of accounting systems and fraud. These are not as readily calculable as underwriting risks and the Finnish group took comfort from the fact that solvency margins are available for both underwriting and other risks. Presumably, the scarcity of data will compel the same course of action for any UK study in respect of many of these risks, although in this report we have sought to quantify some of the risks due to inadequacies in deterministic reporting, which the Finnish study appears to include under this heading.

6 The Risk Theory Model

6.1 The Finnish group developed a theoretical model in a form which could be analysed using the empirical data assembled. The model was based on a development of the simple transition formula:

$$\Delta U = B + I - X - C - D$$

where ΔU = underwriting profit $(U - U_{-1})$

U = solvency margin

B = earned premiums

I = investment income

X = claims incurred

C = expenses

D = dividends paid

6.2 This formula was simplified by means of a number of assumptions. Dividends were assimilated into expenses, and earned premiums less expenses were related to the mean loss ratio plus a safety loading:

$$(1-c-\lambda_p)B = P = E(X)$$

where $c = C/B$

λ_p = safety loading

P = risk premiums

$E(X)$ = expected value of claims

whence $1-c = \bar{f} + \lambda_p$

where $\bar{f}$ = mean loss ratio = $E(X)/B$

6.3 Dividing the original equation throughout by the earned premiums, expressing investment income as made up of interest on technical reserves plus interest on the solvency margin and introducing a generalized safety loading, which includes not only the safety loading in the premiums but interest on the technical reserves (assuming the ratio of technical reserves to earned premiums is 1.71, based on the average of the Finnish data), the formula for the solvency margin per unit of earned premium simplifies to:

$$U = r_{rtot}\, U_{-1} + \bar{f} - f + \lambda$$

where U = solvency ratio (U/B)

r_{rtot} = real rate of return factor

λ = generalized safety loading

f = actual loss ratio

6.4 The model was made probabilistic by allowing the claims to vary stochastically, assuming not only random variation in the number and size of claims but also short term variability in the basic parameters, and cyclical variations and trends. Assumptions were introduced about the effect of catastrophe claims, and all business was taken to be reinsured on the basis of assumed retention levels for each class. Varying assumptions were made about inflation and real growth in premium income, including both steady and sudden change.

6.5 Having developed probability distributions for the stochastic elements and appropriate models for embodying the other factors, the research group carried out large numbers of simulations, displaying the results as stochastic bundles, i.e a superimposition on a single graph of all the simulations from a particular set of assumptions. This produces a strong visual impression with high density in areas which are reached by a large number of simulations and reducing density as the extremes of low probability of occurrence are reached.

6.6 The model contained dynamic elements so as to be self-adjusting in certain respects, eg the premium safety loading factor and the level of net retention could be altered to reflect deteriorating solvency ratios. However, this was not found to be an important element in the model.

6.7 The approach used was to consider an average insurer and then to alter individually the various control variables to assess the sensitivity of the solvency structure to each of those variables. Four main categories of business with different characteristics were employed. Simulations were carried out over a 25 year time span. A ruin barrier of a 10 per cent solvency margin ratio was defined and the number of "ruins" used as a solvency indicator. The intention was to develop criteria for an initial level of solvency margin ratio which would ensure less than one ruin per 100 simulations on average. Other reasons investigated were the range of variation exhibited and the "equilibrium level".

7 Summary

7.1 The Finnish study began with the analysis of a considerable amount of empirical data; similar analysis would be necessary for a corresponding U.K study. Both this and t subsequent model-building would require substantial resources, which are unlikely to be available within the General Insurance Study Group and almost certainly point to academic involvement in the project.

7.2 The size of the Finnish insurance market is such that their study was able to include all companies. Such an approach would be far less feasible in the UK market. Thought would therefore have to be given as to how a representative sample could be derived.

7.3 The Finnish project also appears to have had access to an adequate supply of data in suitable form over a considerable period. In the UK, the position would be different. Data would probably not be available at all before 1970 and data in ideal form would not be readily available prior to 1981. This would considerably restrict the value of any empirical study unless companies could be persuaded to co-operate in producing the required information for past years.

7.4 There are a number of areas which the Finnish study glossed over or ignored, because of the peculiarities of their market. Because of the greater size, spread and general level of sophistication of the UK market, such short cuts would not be possible or desirable. Further development in such areas as asset values and currency risks will therefore be necessary and a more complicated model might be needed for reinsurance and the effects of catastrophe accumulation.

7.5 The basic model, however, would appear to be adaptable to the UK environment. The empirical work referred to above would enable the parameters of the model to be defined. It would also

show whether the various hypotheses and assumptions in the Finnish model were appropriate, or whether they would have to be revised. It should in addition indicate what major factors should be investigated to assess their impact on solvency.

7.6 A detailed study along the lines of the Finnish report will be necessary if the solvency margin factor necessary to provide against the financial risks of continuing to write business for another year is to be quantified (see section 9.6). It would, however, be of very much wider application in examining the overall financial strength of general insurance companies and their ability to withstand a wide range of adverse factors over the longer term. Although the equalization reserve concept has not yet been adopted in the UK, and a different dividing line would have to be drawn here between technical reserves and other free assets of the company, with consequential tax implications for the modelling process, the importance of looking at the resilience of companies' total solvency status in the longer term cannot be overstated as a desirable management objective. It is even possible that a well-researched study in this area could prove useful evidence in putting the case for equalization reserves to be treated as technical reserves by the UK revenue authorities.

APPENDIX 2

VARIABILITY OF LOSS RATIOS

1. One of the first exercises carried out by the Finnish research team was to examine the development of loss ratios over a period of years, first on an individual company basis and then by accounting class, with all companies aggregated together. We have made a very small start along similar lines by compiling details of loss ratios for ten companies over the period 1975 to 1981.

2. The ratio which we considered was

$$\frac{\text{Incurred claims in the year}}{\text{Earned premiums in the year}}$$

However, the information readily available in the Department of Trade returns meant that we were unable to separate out incurred claims arising from exposure in the year in question. Incurred claims, therefore, include adjustments to the reserves for outstanding claims in respect of earlier years' underwriting. This inevitably introduces a considerable amount of distortion into the result, but it will be possible to avoid this problem only for years 1981 and later, when the new format of the returns enables adjustments in respect of earlier years to be excluded.

3. Tables 2.1 to 2.8 show the incurred claims ratios for each accounting class, tabulated by year and by company. Means and standard deviations of the ratios (unweighted) are shown for each row and column. The results show a much greater variability between companies, for all accounting classes except Property, than between years, and there is no strong evidence of cycles emerging over a period of years. Unfortunately the time span examined was relatively short, and it seems likely that there is a considerable amount of smoothing in the results for each company from year to year, achieved, as suggested in Chapter 4, by using the margins in the outstanding claims reserves as a buffer. The very low variability in total loss ratios from year to year (Table 2.8) is particular evidence of this. A much more extensive exercise is clearly needed to examine the results for a reasonable number of smaller companies, where the variability might in any case be expected to be greater, and where the margins available to permit smoothing of results are less.

Table 2.1 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.857	.849	.737	.654	.634	.855	.644	.747	.097
Royal	.852	.747	.744	.729	.651	.852	.976	.793	.099
Guardian	.616	.785	.984	.769	.604	.732	.832	.760	.121
Sun Alliance	.749	.775	.698	.737	.947	1.057	.803	.824	.120
Eagle Star	2.062*	.826	.889	.831	.840	1.100	.907	1.065	.416
Phoenix	.798	.704	.946	.680	.741	.573	.515	.708	.132
Cooperative	.655	.586	.600	.825	.678	.909	.682	.705	.110
Legal and General	.807	.561	.729	.960	1.125	.921	1.106	.887	.189
Cornhill	.724	.559	.521	.565	.560	.512	.693	.591	.077
National Farmers	.644	.577	.534	.571	.605	.873	.932	.677	.147
Mean	.876	.697	.738	.732	.738	.838	.809	.776	.061
Standard deviation	.403	.110	.154	.116	.171	.178	.169	.087	.216

*If this figure is excluded, the mean for 1975 is 0.745 and the standard deviation 0.086, the mean for Eagle Star is 0.899 and the standard deviation 0.095, and the overall mean is 0.757 and the overall standard deviation 0.152.

Table 2.2 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.897	.949	.917	.769	.821	.710	.709	.825	.092
Royal	.820	.835	.857	.831	.895	.876	.735	.836	.048
Guardian	.803	.764	.771	.740	.735	.829	.848	.784	.040
Sun Alliance	.904	.893	.876	.835	.793	.848	.854	.858	.035
Eagle Star	.886	.907	.893	.566	.817	.815	.746	.804	.111
Phoenix	1.070	.918	.963	.938	.910	1.007	.998	.972	.053
Cooperative	.979	1.023	.981	.998	.406	.942	.911	.891	.201
Legal and General	.908	.822	.877	.910	.816	.918	1.215	.924	.125
Cornhill	.907	1.043	.951	.944	1.042	1.113	1.027	1.004	.067
Mean	.908	.906	.898	.837	.804	.895	.894	.877	.037
Standard deviation	.075	.086	.061	.125	.163	.111	.155	.072	.123

Table 2.3 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.755	.824	.774	.708	.736	.741	.665	.743	.046
Royal	.815	.745	.772	.713	.740	.736	.694	.745	.037
Guardian	.732	.728	.794	.772	.830	.769	.692	.760	.043
Sun Alliance	.806	.664	.706	.749	.790	.793	.719	.747	.049
Eagle Star	.668	.701	.719	.775	.795	.725	.716	.728	.040
Phoenix	.945	.904	.894	.925	.964	.893	.756	.897	.063
Cooperative	.618	.562	.609	.730	.732	.754	.684	.670	.068
Legal and General	.815	.772	.899	.879	.970	.975	.891	.886	.069
Cornhill	.701	.692	.704	.739	.772	.758	.666	.719	.035
National Farmers	.629	.672	.689	.709	.717	.784	.728	.704	.045
Mean	.748	.726	.756	.770	.805	.793	.721	.760	.029
Standard deviation	.095	.089	.086	.071	.088	.076	.063	.070	.087

Table 2.4 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.474	.504	.496	.390	.688	.430	.571	.508	.091
Royal	.360	.374	.348	.469	.575	.419	.486	.433	.076
Guardian	.502	.452	.621	.698	.838	.797	.744	.665	.136
Sun Alliance	.468	.595	.614	.645	.626	.482	.439	.553	.080
Eagle Star	.449	.378	.484	.525	.486	.415	.459	.457	.045
Phoenix	.364	.626	.678	.928	.457	.422	.465	.563	.182
Cooperative	.416	.347	.427	.443	.219	.432	.593	.411	.104
Legal and General	1.038	.404	.401	.481	.732	.544	.391	.570	.221
Cornhill	.435	.445	.536	.404	.679	.409	.605	.502	.099
National Farmers	.172	.189	.263	.467	.284	.182	.217	.253	.096
Mean	.468	.431	.487	.545	.558	.453	.497	.491	.043
Standard deviation	.210	.120	.124	.158	.187	.144	.135	.107	.163

PERSONAL ACCIDENT

Table 2.5 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.483	.703	.675	.515	.534	.486	.496	.556	.086
Royal	.532	.490	.535	.509	.508	.466	.485	.504	.023
Guardian	.395	.455	.448	.478	.462	.301	.539	.440	.069
Sun Alliance	.486	.439	.497	.439	.420	.458	.350	.441	.045
Eagle Star	.480	.429	.567	.578	.566	.524	.416	.509	.063
Phoenix	.591	.684	.710	.642	.740	.670	.660	.671	.044
Cooperative	.507	.554	.445	.546	.497	.497	.467	.502	.036
Legal and General	.604	.684	.999	1.456	.950	.402	.046	.734	.421
Cornhill	.575	.545	.518	.596	.645	.555	.429	.552	.063
National Farmers	.619	.686	.630	.619	.548	.616	.695	.630	.046
Mean	.527	.567	.602	.638	.587	.498	.458	.554	.058
Standard deviation	.067	.107	.157	.279	.149	.099	.054	.092	.170

Table 2.6 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.637	.594	.543	.584	.615	.604	.557	.591	.030
Royal	.594	.618	.560	.548	.604	.560	.485	.567	.041
Guardian	.522	.595	.690	.551	.700	.590	.625	.610	.062
Sun Alliance	.507	.669	.556	.614	.678	.555	.543	.589	.061
Eagle Star	.567	.669	.609	.636	.594	.598	.574	.607	.033
Phoenix	.496	.717	.698	.632	.667	.658	.603	.639	.068
Cooperative	.502	.614	.647	.610	.641	.623	.651	.613	.048
Legal and General	.560	.672	.547	.519	.685	.575	.527	.584	.063
Cornhill	.575	.579	.577	.597	.670	.645	.491	.591	.053
National Farmers	.540	.720	.565	.554	.572	.496	.532	.568	.066
Mean	.550	.645	.599	.584	.643	.590	.559	.596	.034
Standard deviation	.043	.049	.056	.038	.042	.045	.052	.021	.058

Table 2.7 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.635	.626	.267	.460	.718	.607	.625	.563	.140
Royal	.822	.610	.668	.576	.557	.568	.605	.629	.086
Guardian	.653	.611	.590	.600	.625	.709	1.284	.725	.413
Sun Alliance	.708	.680	.680	.628	.645	.689	.741	.682	.035
Eagle Star	.696	.690	.770	.766	.724	.725	.699	.724	.030
Phoenix	2.398*	.806	.781	.640	.623	.884	.853	.998	.579
Cooperative	.667	.661	.577	.599	.586	.612	.757	.637	.059
Legal and General	.537	.609	.612	.609	.763	.650	.686	.638	.066
Cornhill	.684	.702	.598	.609	.597	.726	.747	.666	.059
Mean	.867	.666	.616	.610	.649	.686	.777	.696	.083
Standard deviation	.546	.060	.142	.074	.066	.088	.192	.117	.248

*If this figure is excluded, the mean for 1975 is 0.675 and the standard deviation 0.075, the mean for Phoenix is 0.764 and the standard deviation 0.100, and the overall mean is 0.668 and the overall standard deviation 0.122.

Table 2.8 Ratio of Claims Incurred to Earned Premiums 1975-1981

Company	1975	1976	1977	1978	1979	1980	1981	Mean	Standard deviation
Commercial Union	.719	.737	.633	.637	.682	.674	.622	.672	.041
Royal	.712	.663	.656	.625	.648	.637	.605	.649	.031
Guardian	.651	.662	.724	.674	.729	.707	.737	.698	.032
Sun Alliance	.667	.696	.656	.667	.712	.674	.650	.675	.020
Eagle Star	.685	.726	.742	.726	.733	.758	.689	.723	.025
Phoenix	.807	.868	.827	.765	.753	.816	.764	.800	.039
Cooperative	.584	.587	.620	.677	.678	.695	.671	.645	.043
Legal and General	.691	.664	.681	.679	.800	.698	.657	.696	.045
Cornhill	.678	.678	.660	.684	.729	.712	.643	.683	.027
National Farmers	.598	.670	.625	.641	.654	.697	.684	.653	.032
Mean	.679	.695	.682	.678	.712	.707	.672	.689	.014
Standard deviation	.060	.070	.061	.040	.045	.047	.047	.044	.055

APPENDIX 3
ACCOUNTING POLICIES FOR OUTSTANDING CLAIMS

We set out below the statements of accounting policies in the Companies Act accounts of the seven largest composite offices together with the two quoted life offices with substantial non-life portfolios. Returns under the Insurance Companies Acts do not now usually contain any comparable statement although in many cases the figures used are consistent with those given in the accounts.

Commercial Union

Full provision is made for the estimated cost of all claims notified but not settled at the date of the balance sheet, less reinsurance recoveries, using the best information available at that time. Provision is also made for the cost of claims incurred but not reported until after the balance sheet date (IBNRs) and for the estimated administrative expenses that will be incurred after the balance sheet date in settling all claims outstanding at that date, including IBNRs. Significant delays are experienced in both the notification and settlement of claims, particularly in respect of liability and marine claims. Accordingly, a substantial measure of experience and judgement is required in assessing such outstanding claims, the ultimate cost of which cannot be known with certainty at the balance sheet date. Differences between the provisions for outstanding claims at a balance sheet date and subsequent revisions and settlements are included in the revenue account in later years, except for movements in rates of exchange.

Eagle Star

Provision is made for the full estimated cost of claims to be paid in respect of incidents up to 31 December including those which had not been notified to the group by 31 December. Any differences between the estimated cost and subsequent settlement are dealt with in the revenue accounts of following years.

General Accident

Provisions for notified claims as at 31 December each year are determined on an individual case basis after taking into account anticipated inflation and trends in settlements.

Provision is also made in respect of claims incurred but not reported at 31 December based on statistical methods.

Any differences between original claims provisions and subsequent re-estimates or settlements are reflected in the underwriting results of the years in which claims are re-estimated or settled.

GRE

Full provision is made for outstanding claims including those incurred but not reported until after 31 December. Outstanding claims provisions, although not capable of precise assessment, are made in the light of information available and after taking account of expected inflation and trends in future settlements.

Phoenix

Outstanding claims represent claims arising from incidents prior to the accounting date, or the end of the closed treaty year, but not settled at the relevant dates and include provision for the probable cost of claims incurred but not reported by the date on which records for the year are closed.

Royal

Outstanding claims comprise the estimated cost of all claims incurred but not settled at the balance sheet date, whether reported or not.

Sun Alliance

Outstanding Fire and Accident claims include provisions for claims incurred but not reported up to the date of the balance sheet.

Legal and General

Provision is made for the full estimated cost of (i) claims notified but not settled (ii) claims incurred but not yet notified and (iii) claims handling expenses. In the case of overseas workers compensation business the full estimated cost is discounted at an appropriate rate of interest to take account of the delay in settlin claims for this type of business.

Prudential

Outstanding claims include provisions for claims incurred but not reported at the balance sheet date.

APPENDIX 4

Derivation of Margin Factors from Estimates of Outstanding Claims

1. During the run-off of a cohort of claims from a particular year of origin, frequent adjustments are made to the estimated total cost of claims, eventually homing in on the actual known cost when the cohort has run-off to extinction. The estimate of outstanding claims at any point in the run-off is a function of the company's estimating policy (e.g conservative estimate at end of year 1, release most of margins at end of year 2, etc) and state of knowledge of claims costs at that stage in the development, with a super-imposed random element.

2. We suppose that the actual outstanding claims at the end of year of development j, expressed as a proportion of the mean estimate of outstanding claims at that time , is x_j, and that the distribution about the mean has standard deviation s_j. We term this random variable the fluctuation measure. We have a sample of values p_{ij} from which to estimate x_j and s_j, where p_{ij} is the value of the sample fluctuation measure for year of origin i and year of development j defined as the latest estimate of the outstanding claims taking account of the development of the year of origin so far divided by the estimated outstanding claims at that time. We calculate the sample mean and variance as:

$$\bar{x}_j = \frac{1}{n_j} \sum_{i=1}^{n_j} p_{ij}$$

$$\bar{s}_j = \frac{1}{n_j} \sum_{i=1}^{n_j} (p_{ij} - \bar{x}_j)^2$$

where n_j is the number of sample values available for the year of development j ($n_j = m-j$; where n is the total number of years of origin available). Estimates of the actual mean and variance of the distribution are then given by

$$\hat{x}_j = \bar{x}_j = \frac{1}{n_j} \sum_{i=1}^{n_j} p_{ij}$$

$$\hat{s}_j = \frac{n_j}{n_j - 1} \bar{s}_j = \frac{1}{n_j - 1} \sum_{i=1}^{n_j} (p_{ij} - \bar{x}_j)^2$$

3. We consider a set of data for a moderate sized motor account, with the various risk groups combined. The run-offs of cumulative claims paid and of claims paid and estimated outstanding are shown (in £thousands) for years of origin 1974 to 1981 in Tables 4.1 and 4.2. Table 4.3 shows the estimated outstanding claims at the end of each development year whilst Table 4.4 gives the revised estimate of outstanding claims at the end of each development year, taking into account the latest estimate of total claims paid and estimated outstanding. Table 4.5 shows the sample fluctuation measures, leaving out the diagonal, which has value unity throughout by definition. Table 4.6 then uses the estimated mean values of sample fluctuation measures and the mean variance to estimate outstanding claims for each year of origin and the associated variance.

4. Table 4.6 indicates mean outstanding claims of 9950 (compared with the company's current estimate of 11292) with standard deviation 586, giving an implicit K margin factor of 2.29. To test the stability of this result we examine in table 4.7 the effect of including more or fewer years of origin in the calculation.

Table 4.1 Cumulative claims paid

Year of Origin	Year of Development									Estimated Outstanding
	1	2	3	4	5	6	7	8	9	
1972	1150	1935	2269	2497	2603	2638	2644	2649	2651	7
1973	1430	2420	2767	2937	3094	3181	3209	3224		21
1974	1695	2905	3274	3613	3787	3885	3987			157
1975	2181	3540	3925	4367	4698	4815				101
1976	2611	4845	5481	6020	6532					568
1977	3821	6253	6975	7629						1341
1978	3369	5451	6149							1722
1979	3677	6043								2524
1980	4392									4852

Table 4.2 Claims paid and estimated outstanding

Year of Origin	Year of Development								
	1	2	3	4	5	6	7	8	9
1972	2771	2773	2875	2761	2714	2675	2662	2656	2658
1973	3721	3595	3449	3312	3298	3292	3257	3245	
1974	4473	4408	4117	4100	4186	4127	4144		
1975	5640	4983	4933	5044	4937	4916			
1976	7503	7249	7091	7076	7099				
1977	9342	8952	9113	8970					
1978	8050	7855	7871						
1979	8900	8567							
1980	9244								

Table 4.3 Estimated outstanding claims at end of development year

Year of Origin	Year of Development								
	1	2	3	4	5	6	7	8	9
1972	1621	838	606	264	111	37	18	7	7
1973	2291	1175	682	375	204	111	48	21	
1974	2778	1503	843	487	399	242	157		
1975	3459	1443	1008	677	239	101			
1976	4892	2404	1610	1056	567				
1977	5521	2699	2138	1341					
1978	4681	2404	1722						
1979	5223	2524							
1980	4852								

Table 4.4 Latest estimate of outstanding claims

Year of Origin	Year of Development								
1972	1508	723	389	161	55	20	14	9	7
1973	1815	825	478	308	151	64	36	21	
1974	2449	1239	870	531	357	259	157		
1975	2735	1376	991	549	218	101			
1976	4488	2254	1618	1079	567				
1977	5149	2717	1995	1341					
1978	4502	2420	1722						
1979	4890	2524							
1980	4852								

Table 4.5 Sample fluctuation measures

Year of Origin	Year of Development							
	1	2	3	4	5	6	7	8
1972	.930	.863	.642	.610	.495	.541	.778	1.286
1973	.792	.702	.701	.821	.740	.577	.750	
1974	.882	.824	1.032	1.090	.895	1.070		
1975	.791	.954	.983	.811	.912			
1976	.917	.938	1.005	1.022				
1977	.933	1.007	.933					
1978	.962	1.007						
1979	.936							
Estimate of:								
Mean	.893	.899	.883	.871	.760	.729	.764	1.286
Variance	.00441	.01227	.02816	.03625	.03732	.08736	.00039	-

Table 4.6 Derivation of mean and variance of outstanding claims

Year of Origin	Co est of o/s claims	Estimate of mean s.f.m	Mean Estimate of o/s	Estimate of variance of s.f.m	Estimated variance of o/s claims
1972	7	say 1	7	-	-
1973	21	1.286	27	-	-
1974	157	.764	120	.00039	10
1975	101	.729	74	.08736	891
1976	567	.760	431	.03732	11998
1977	1341	.871	1168	.03625	65188
1978	1722	.883	1521	.02816	83502
1979	2524	.899	2269	.01227	78167
1980	4852	.893	4333	.00441	103820
	11292		9950		343576
					(s.d 586)

Company Estimate (11292) = 9950 + 2.29 (586)

$\therefore K = 2.29$

Table 4.7 Stability of implied K factor (1970 to 1980)

Years of origin included	Estimate of o/s claims *	Estimated standard derivation	K margin factor
1970-1980	10165	789	1.43
1971-1980	10013	569	2.25
1972-1980	9952	586	2.29
1973-1980	10163	547	2.07
1974-1980	10587	408	1.73
1975-1980	10581	398	1.79

*including company's estimate for earlier years

5. Apart from the 1970 year of origin, which is out of line with the rest of the run-off triangle in showing significant underestimation of claims at the end of the first year of development, the above results are reasonably consistent, pointing to a K margin factor of around 2. However, an interesting shift in the results takes place if we include the 1981 figures for each year of origin.

Table 4.8 Stability of implied K factor (1971 to 1981)

Years of origin included	Estimate of o/s claims *	Estimated standard derivation	K margin factor
1971-1981	13133	993	0.47
1972-1981	13231	1060	0.35
1973-1981	13861	957	-0.27
1974-1981	14215	797	-0.77
1975-1981	14347	821	-0.91

* including company's estimate for earlier years

6. The K margin factors based on years up to and including 1981 do not exhibit the same stability as when only the run-off up to 1980 is considered. This is because of significant strengthening in 1981 of the outstanding claims reserves for years of origin 1973 to 1979, resulting in almost a 3 per cent increase in the estimate of total claims paid and outstanding for all years of origin up to and including 1980. The effect of the strengthening was greatest on years of origin 1976 to 1979, for which a significant proportion of the total claims cost is accounted for by estimated outstanding claims, and has resulted in sample fluctuation measures in excess of unity for most recent years of origin, as shown in Table 4.9.

Table 4.9 Sample fluctuation measures (including 1981 data)

Year of Origin	Year of Development								
	1	2	3	4	5	6	7	8	9
1972	.927	.857	.634	.591	.450	.405	.500	.571	.286
1973	.804	.724	.739	.891	.868	.811	1.292	2.238	
1974	.902	.862	1.098	1.205	1.035	1.302	1.357		
1975	.799	.974	1.013	.855	1.038	1.297			
1976	.937	.978	1.066	1.115	1.173				
1977	1.016	1.178	1.149	1.345					
1978	1.060	1.198	1.267						
1979	1.066	1.269							
1980	.966								

7. It is clear from the pattern of increasing sample fluctuation measures by year of origin for each year of development that a lower K margin factor will be obtained the more the earlier years are left out of account. However, where there is a discontinuity in the reserving basis, the method does not yield any useful information in terms of forecasting outstanding claims, since it implicitly projects further strengthening. In fact the more prudent the basis for strengthening the reserves, the higher the underestimation that will be suggested.

8. Some idea of the significance of the shift in 1981 can be obtained by looking at the K factors derived for 1979, 1980, 1981 and 1982.

Table 4.10 Development of K factors 1979 to 1982

Earliest year of origin considered	K margin factor based on data to:			
	1979	1980	1981	1982
1971	2.31	2.25	0.47	0.85
1972	2.30	2.29	0.35	0.84
1973	2.01	2.07	-0.27	0.36
1974	1.62	1.73	-0.77	0.23
1975	1.61	1.79	-0.91	0.34

9. Further examples of the derivation of K margin factors are given in Appendix 5.

APPENDIX 5

Estimation of K margin factors and comparisons with other indicators

1. Tables 5.1 to 5.5 show the results of applying the method described in Appendix 4 to the data for 20 U K companies, including the major composites and a few smaller undertakings. The database used was the claims settlement analyses contained in the 1980 returns.
The tables show:

a) the company's own estimate of outstanding claims as at 31 December 1980;

b) the estimate of outstanding claims obtained by applying the chain ladder method to the run-off triangle of paid claims;

c) the estimate of outstanding claims obtained by applying the chain ladder method to the run-off triangle of total estimated claims, paid and outstanding;

d) the mean estimate of outstanding claims using the method described in Appendix 4;

e) the estimate of the standard deviation of outstanding claims using the method described in Appendix 4;

f) the estimated K margin factor based on (a), (d) and (e);

g) an indication of whether the total estimate of claims paid and outstanding for underwriting years 1977 and earlier had been increased during the period 31 December 1977 to 31 December 1980;

h) the amount of reserves released during 1981 for this class of busines (from Form 20 line 42 of the 1981 returns - although this may include business in the accounting class not covered by the claims settlement analysis); and

i) the standard deviation (e) expressed as a percentage of the mean estimate of outstanding claims (d).

2. The figures in columns (a) to (e) and in column (h) are in £thousands. The 20 companies are tabulated in order of decreasing K margin factor for motor vehicle business. This was done for convenience, although, as explained in Chapter 4, care must be taken not to ascribe too much significance to individual values of K derived by a method such as this without carrying out other investigations.

3. It will be seen that there is a degree of correlation between negative K margin factors and where estimates of total claims have had to be revised upwards over the previous 4 years. This is what one would expect if reserves for outstanding claims were in fact inadequate, but as has been shown in Appendix 4, an abnormally low K margin factor can result from strengthening of the reserves in the most recent year, and does not necessarily imply that underprovision still exists. Further investigations would be necessary to establish the position.

4. For the purposes of assessing a suitable level of solvency margin to cover the variability in the run-off of outstanding claims, we calculated the average of column (i), and also the weighted average ratio of standard deviation to mean outstanding claims by summing columns (d) and (e). The results were as follows:

Class of business	Average ratio SD/Mean	Weighted average ratio	Average excluding outliers	$\frac{1\frac{1}{2}6}{\mu+1\frac{1}{2}6}$
Motor Vehicle	9.3	6.8	7.9	10.6
Property	10.6	9.8	10.6	13.7
Liability	11.3	7.3	11.3	14.4
Pecuniary loss	20.9	12.6	15.0	18.4
Personal Accident	31.2	18.6	15.6	19.0

If technical reserves are to be based on a minimum of $\mu+1\frac{1}{2}6$, and the solvency margin is to be at least a further $1\frac{1}{2}6$, we require the ratio

$$\frac{1\frac{1}{2}6}{\mu + 1\frac{1}{2}6}$$

This is given in the last column, based on the average ratio in Tables 5.1 to 5.5 excluding outliers.

TABLE 5.1 Estimates of outstanding claims and derivation of K margin factors

MOTOR VEHICLE

Company	Estimates of o/s claims								
	Company estimate of o/s claims (a)	BCL on paid claims (b)	BCL on paid & o/s (c)	Appendix 4 method (d)	Standard deviation (Appendix 4 method) (e)	Estimated K margin factor (f)	Strengthening of reserves 1977 to 1981? (g)	Release of reserves in 1981 (h)	S.D as % of mean o/s (i)
A	60937	62816	39827	47104	3414	4.1	No	8846	7.2
B	52057	49927	35877	40922	3557	3.1	No	6303	8.7
C	156694	160140	124632	136163	6923	3.0	No	15704	5.1
D	11295	10580	9973	10047	559	2.2	No	-	5.6
E	29549	26127	26025	26124	1764	1.9	No	1100	6.8
F	29746	26791	26685	26091	2096	1.7	No	3220	8.0
G	19583	18554	18622	18256	961	1.4	No	204	5.3
H	75502	77699	73430	72574	2544	1.2	Yes	1420	3.5
I	76892	71692	69278	72397	4051	1.1	No	5878	5.6
J	34918	43938	35483	34028	2393	0.4	No	5928	7.0
K	113000	115165	111862	113236	6554	0.0	No	3551	5.8
L	69555	59846	69402	69960	5710	-0.1	No	462	8.2
M	1463	830	2241	1616	555	-0.3	No	-	34.3
N	33668	38844	35333	34131	1222	-0.4	Yes	2297	3.6
O	5840	8627	7419	6572	1394	-0.5	Yes	286	21.2
P	33571	34278	35066	34501	1384	-0.7	No	-	4.0
Q	36974	44527	39493	39070	2767	-0.8	No	1958	7.1
R	18674	23637	24729	27149	6721	-1.3	Yes	2348	24.8
S	9328	11804	10550	10243	514	-1.8	Yes	-	5.0
T	20828	26456	26958	25732	2191	-2.2	Yes	1095	8.5

TABLE 5.2 Estimates of outstanding claims and derivation of K margin factors

PROPERTY

Company	Company estimate of o/s claims (a)	Estimates of o/s claims: BCL on paid claims (b)	BCL on paid & o/s (c)	Appendix 4 method (d)	Standard deviation (Appendix 4 method) (e)	Estimated K margin factor (f)	Strengthening of reserves 1977 to 1981? (g)	Release of reserves in 1981 (h)	S.D as % of mean o/s (i)
A	71247	73112	40404	53098	3202	5.7	No	11795	6.0
B	53246	51664	32771	34138	7105	2.7	No	11518	20.8
C	64479	55746	42560	47057	2653	6.6	No	15529	5.6
D	7280	7032	5161	5812	475	3.1	No	-	8.2
E	6831	3954	5049	4719	495	4.3	No	2267	10.5
F	8609	5948	6258	6171	735	3.3	No	1092	12.0
G	67553	39840	53004	53549	5539	2.5	No	9536	10.3
H	48775	46673	29804	36168	3213	3.9	No	5683	8.9
I	46284	39361	23191	28090	3642	5.0	No	6538	13.0
J	70313	69760	52939	54569	3851	4.1	No	9011	7.1
K	31263	32812	16892	21087	2591	3.9	No	2545	12.3
L	22688	17933	19692	19640	1512	2.0	No	3299	7.7
M	3069	5269	2510	2710	395	0.9	No	-	14.6
N	28443	29474	15817	20709	2032	3.8	No	349	9.8
O	1968	1287	1564	1650	210	1.5	No	285	12.7
P	1735	1109	1380	1304	194	2.2	Yes	-	14.9
Q	12001	8645	8431	8810	613	5.2	No	3201	7.0
R	24525	26749	18154	18509	1995	3.0	No	4417	10.8
S	8001	5460	6070	6168	414	4.4	No	-	6.7
T	24564	23266	17689	19851	2508	1.9	No	2134	12.6

TABLE 5.3 Estimates of outstanding claims and derivation of K margin factors

LIABILITY

Company	Estimates of o/s claims: Company estimate of o/s claims (a)	BCL on paid claims (b)	BCL on paid & o/s (c)	Appendix 4 method (d)	Standard deviation (Appendix 4 method) (e)	Estimated K margin factor (f)	Strengthening of reserves 1977 to 1981? (g)	Release of reserves in 1981 (h)	S.D as % of mean o/s (i)
A	90713	76451	96648	82823	6016	1.3	No	(7454)	7.3
B	71077	60616	69742	68147	3819	0.8	No	5907	5.6
C	49867	37463	33439	40404	1946	4.9	No	1273	4.8
D	5646	4200	5194	5161	574	0.8	Yes	-	11.1
E	11523	8841	10050	9195	988	2.4	No	439	10.7
F	11535	9717	10316	10170	1277	1.1	No	431	12.6
G	88618	79934	107971	104116	10717	-1.4	Yes	6120	10.3
H	196725	187802	250682	227851	8578	-3.6	Yes	(106)	3.8
I	65186	46160	53875	57185	3770	2.1	No	(5915)	6.6
J	132306	105922	158888	156532	14823	-1.6	Yes	12582	9.5
K	24079	19621	23064	23759	2132	0.2	No	149	9.0
L	8414	8246	7862	8106	835	0.4	Yes	(508)	10.3
M	10124	8048	8833	9865	1542	0.2	No	-	15.6
N	20949	12431	21052	21075	1783	-0.1	Yes	(3481)	8.5
O	2743	1578	3368	2729	1251	0.0	Yes	(163)	45.8
P	1957	1061	1350	1795	397	0.4	No	-	22.1
Q	8716	6657	7497	8735	637	0.0	No	494	7.3
R	21149	24187	19302	22150	1901	-0.5	No	4490	8.6
S	26371	31163	33226	31036	1889	-2.5	Yes	-	6.1
T	19428	11727	20155	22787	2154	-1.6	Yes	(615)	9.5

TABLE 5.4 Estimates of outstanding claims and derivation of K margin factors

PECUNIARY LOSS

Company	Company estimate of o/s claims (a)	Estimates of o/s claims: BCL on paid claims (b)	BCL on paid & o/s (c)	Appendix 4 method (d)	Standard deviation (Appendix 4 method) (e)	Estimated K margin factor (f)	Strengthening of reserves 1977 to 1981? (g)	Release of reserves in 1981 (h)	S.D as % of mean o/s (i)
A	17895	18920	9726	12209	904	6.3	No	4625	7.4
B	13235	25395	4692	8439	1021	4.7	No	1614	12.1
C	13162	10584	7642	8518	843	5.5	No	2761	9.9
D	952	1022	693	710	97	2.5	No	-	13.7
E	183	63	53	131	47	1.1	No	13	35.9
F	1747	2411	935	1235	326	1.6	No	360	26.4
G	2593	1676	1877	2027	339	1.7	No	227	16.7
H	7687	10372	4172	5509	586	3.7	No	1275	10.6
I	9326	15262	3889	4790	1033	4.4	No	4603	21.6
J	16064	20350	15041	13228	1376	2.1	No	2725	10.4
K	6933	17940	3437	4444	762	3.3	No	1528	17.1
L	748	473	422	440	85	3.6	No	162	19.3
M	1473	1360	992	1036	186	2.3	No	-	18.0
N	2598	3925	1008	1630	227	4.3	No	257	13.9
O	208	408	74	142	157	0.4	Yes	50	110.6
P	305	241	190	203	35	2.9	No	-	17.2
Q	1766	3001	962	1172	162	3.7	No	77	13.8
R	7357	9500	4723	5452	520	3.7	No	1486	9.5
S	823	1500	507	536	80	3.6	No	-	14.9
T	4792	5009	4598	4183	766	0.8	Yes	366	18.3

TABLE 5.5 Estimates of outstanding claims and derivation of K margin factors

PERSONAL ACCIDENT

Company	Company estimate of o/s claims (a)	Estimates of o/s claims: BCL on paid claims (b)	BCL on paid & o/s (c)	Appendix 4 method (d)	Standard deviation (Appendix 4 method) (e)	Estimated K margin factor (f)	Strengthening of reserves 1977 to 1981? (g)	Release of reserves in 1981 (h)	S.D as % of mean o/s (i)
A	1757	1843	803	1508	180	1.4	No	144	11.9
B	2386	2210	1963	1898	368	1.3	Yes	187	19.4
C	1591	1302	1385	1326	167	1.6	No	26	12.6
D	239	279	298	299	23	-2.5	Yes	-	7.7
E	372	404	310	317	20	2.7	No	55	6.3
F	339	622	255	310	62	0.5	No	82	20.0
G	897	476	664	746	153	1.0	No	242	20.5
H	1668	1236	1536	1811	298	-0.5	Yes	343	16.5
I	820	467	862	850	99	-0.3	No	(169)	11.6
J	4210	2497	3944	4040	559	0.3	No	465	13.8
K	2779	3693	3428	3488	485	-1.5	Yes	10885)	13.9
L	316	300	311	370	121	-0.4	Yes	2	32.7
M	42	37	32	73	80	-0.4	No	-	109.6
N	602	531	556	555	33	1.4	No	(73)	5.9
O	43	32	59	336	533	-0.6	Yes	(2)	158.6
P	25	48	33	53	48	-0.6	Yes	-	90.6
Q	505	511	366	410	51	1.9	No	130	12.4
R	1119	1138	750	1165	239	-0.2	No	103	20.5
S	256	266	281	287	35	-0.9	Yes	-	12.2
T	1270	912	1062	1430	395	-0.4	Yes	489	27.6