GENERAL INSURANCE STUDY GROUP - SOLVENCY WORKING PARTIES

3   REINSURANCE & OTHER ASPECTS

A General Introduction

The working party consisted of :-

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The report was produced as a result of the discussion of working notes on specific aspects by individual members of the group. Thus, an agreed report was generated, and as a consequence although different individuals wrote different parts of the final report, they are not attributed to the authors, as this could give a misleading impression.

The subject of reinsurance and particularly its solvency aspects is a most appropriate one for study at the present time in view of the generally agreed weakness of the world reinsurance market. This is fairly typically summed up in the following quotation from a recent insurance publication.

> "It is not easy to get the world reinsurance industry to agree on anything. But one point on which most senior people in the industry are in accord is that sooner or later and quite probably sooner, there is going to be a massive crash in the industry that will wipe out a lot of the newer and smaller names in the reinsurance field and badly hurt some of the larger ones as well".

Clearly, if such a crash occurs, it will be more than just reinsurers who are affected.

The weakness of the reinsurance market must be of great concern to supervisory authorities. Before we can describe a system for monitoring reinsurance and reinsurers, we need to understand how the present weakness within the industry has come about. The following are some of the primary reasons :-

1)   Over-capacity in the Reinsurance Market - recent years have seen huge increases in both the number of professional reinsurance companies and in the number of 'names' writing through Lloyd's. This increased competition has led to a price war in which rates have been cut to what many consider to be a suicidal level.

2)   Lack of Technical Expertise - it is common for reinsurers to lack technical expertise in the fixing of both rates and reserves. This is not to say that there are not many extremely competent reinsurance companies. However, there is also a great number of reinsurers who justify the description "cowboys".

3) Overlining - In order to make an impact on the market, some reinsurers write much larger lines than they intend to keep, reinsuring the surplus with an overriding commission. As the business is passed from one reinsurer to another, the overriders and brokerage erode the profitability of the business. The interdependency caused by such retrocessions could lead to a 'domino' effect in the event of a major catastrophe.

4) Post Financing - reinsurers currently operate in a system of post financing. The losses from major events are to a large extent recouped by increasing future premiums, rather than being anticipated and reserved in advance. This philosophy, of course, assumes that the reinsurer is still solvent after the event.

5) Taxation of Catastrophe Reserves - in the U K., catastrophe reserves can only be established from post-tax funds. This causes insurers to hold as much as possible of their catastrophe reserve in the form of margins in the valuation of outstanding claims.

   For the supervisor, this practice must be very inconvenient because it is difficult to judge the amount of funds that could be made available to meet the liability from a catastrophic event.

   In the present reinsurance market, the practice can also mask a trend of deteriorating financial strength as the hidden catastrophe fund is consciously, or unconsciously, depleted to top up a poor trading result.

6) Social and Technological Changes - since World War II there has been rapid expansion of industry with bigger factories and warehouses and industrialisation of undeveloped countries. The use of nuclear power is spreading throughout the world. In insurance there is a demand to cover unchartered risks arising from new technology (e.g. computer leasing) and a demand to cover political risks due to the spread of terrorism. These factors increase both the scope and intensity of possible catastrophe events.

7) Currency Problems - since reinsurance is an international business, reinsurers operate in many currencies. This is particularly true of marine and aviation business.

   In recent years, exchange fluctuations have been particularly violent, and underwriters must bear these risks as part of their business. Unfortunately, the accounting systems of many reinsurers were not built to withstand exchange fluctuations of this magnitude. An inadequate accounting system can lead to insolvency in three ways :-

   (a) Misinterpretation of insurance profit at the end of a year in which there has been a marked movement in exchange rates.

   (b) Misinterpretation of claim development following a period of continuous strenghtening of the reinsurer's own currency.

(c)   By providing inadequate information for asset
        matching by currency. Asset matching is however,
        particularly difficult for a reinsurer since a
        new large claim will always unbalance a previously
        matched position. However a company may decide
        instead to avoid certain currencies and invest in an
        alternative currency which is considered likely to
        be stronger. A further problem is the possibility
        of treaties being written in a currency other than
        that of the original risks, or even claims being
        settled in the currency of the country in which the
        loss occurred rather than that of the country where
        the premium was paid.

Having thus introduced the subject, we now consider the theoretical aspects
of reinsurance programmes and retentions in Section B and C, before turning
to the current and potential future supervision of reinsurance business
ceded and accepted.

SECTION B - PRINCIPLES AFFECTING REINSURANCE PROGRAMMES

(i) General

The reinsurance programme for a company is likely to be affected by the same principles, irrespective of the type of company involved. However, the actual reinsurance programme most appropriate will vary because:

(a) the importance attached to the various principles will differ according to the type and size of the company involved.

(b) the cost of alternative programmes will vary according to the state of the reinsurance market.

The reinsurance programme should take account of the following:-

1. The possibility of ruin resulting from a catastrophe. For this purpose a catastrophe is defined as a single large claim or a series of related claims.

2. The extent of the company's free reserves, since these will provide an alternative form of protection against insolvency.

3. The extent to which the business being written is subject to year-to-year fluctuations in claims experience. Such fluctuations may be of a random or a cyclical nature.

4. The level of adequacy of the premium rates to provide for the expected risk, together with the possibility that the risk has been underestimated. Such underestimation can arise from a wide variety of causes, the most obvious being over-optimistic assessment of future trends in inflation, etc.

5. The extent to which the company wishes to smooth its underwriting results.

6. The intended rate of expansion of the business, as a higher expansion rate may necessitate a greater percentage cession to reinsurance.

7. The possibilities of reciprocal business being obtained from the reinsurers.

8. The identity of the proposed reinsurers from the point of view of their ability to meet any claims made against them. In this connection, the solvency position of the reinsurer has a direct bearing on the solvency of the reinsured. However it is often difficult for the direct company to determine the relevant characteristics of the prospective reinsurers. Furthermore the reinsurers themselves will probably retrocede some of the business which makes the problem of selection of reinsurers even greater.

9. Any local legislation regarding particular reinsurance arrangements.

10. The prestige involved in writing large risks.

11. The identity of the reinsurance brokers. In the case of some Lloyds brokers, the broker and risk-carrier may be inter-related.

Given these points, the reinsurance arrangements should attempt to obtain the greatest available benefit at the least cost, but bearing in mind long-term considerations, such as the fact that it is to the advantage of the direct insurer that a healthy reinsurance market exists.

The cost involved depends on:

(a) the expenses incurred in administering the reinsurance programme

(b) the commissions available - it should be noted that the existence of an over-rider can give the direct company a guaranteed income, which minimises fluctuations.

(c) the nature of the various available inflation and currency clauses, and the impact they will have given different assumptions as to future trends.

(d) the cash flow implications of the reinsurance programme, especially the size of any deposit premiums.

These principles tend to emphasize the need for solvency protection, but in fact, only half of the points made above are directly connected with solvency.

The type or types of reinsurance most appropriate to a particular company or a particular class will depend on the weights given to the above points in the company's philosophy, and the following sections consider a few types of company from this viewpoint.

(ii) The Practical Implications for a Specialist Fire and Accident Company

By a specialist fire and accident company we mean a company specialising
in one class of fire and accident business.

The actual reinsurance programme will depend on which class of business
is being written, but irrespective of this, the important factors will be:

1. The extent to which the company is exposing itself to the possibility
    of catastrophe - there is likely to be a lack of "spread" since only
    one class is involved.

2. The extent to which results are liable to vary from year to year -
    this is particularly important if the class being written is subject
    to cyclical patterns.

3. The adequacy of the premium rates is likely to be very important,
    because of the lack of other classes to compensate for any inadequacy
    in the specialist class. However there are at least two problems
    in using reinsurance to improve this situation:

    (a) the reinsurance solution can only be considered as a short-term
         alleviation of the problem, as in the longer term the reinsurer
         will require a profit - inadequate rates for the direct business
         are unlikely to be attractive to reinsurers.

    (b) the treaty most appropriate is stop loss, and this is almost
         impossible to acquire, especially in these circumstances.

4. Reciprocity may be very important, especially to improve geographical spread.

5. The prestige of writing large risks may be a factor in some specialist
    companies, but in general it appears to be composites who are more
    concerned on this score.

As a result of these factors excess-of-loss reinsurance is likely to
be required (1) and possibly stop-loss if available (3), and quota
share (4). Factors 2 and 5 are likely to affect the proportion of
premium ceded to reinsurers rather than the types required.

All in all protection of solvency is the prime reason for reinsuring.

(iii) The Practical Implications for a Composite Company

For a composite company, there is inevitably a greater spread of risk than for a specialist, so that less reinsurance would seem to be justified. However, in many such companies, it appears that each account is protected by reinsurance as if it stood by itself. Theoretically the most important factors are:

1. The extent to which the company is exposing itself to the possibility of catastrophe - this can be a particularly important point if the catastrophe is liable to affect more than one class of business. Nevertheless, a composite is liable to benefit to some extent from its greater spread of risk than will a specialist company.

2. The adequacy of the premium rates - this is also less important for a composite, although if a company underestimates the effects of future inflation in one class, it is reasonable to expect that it may do the same for other classes.

3. The extent to which the company wishes to smooth its underwriting results - there is a tendency for composites to be concerned as to the stability of their profit and its effect on Stock Market valuations, etc.

4. The prestige gained by being in a position to write the larger risks - this is also tied in with the previous point, being involved in protecting the company's image.

As a result of these factors, excess-of-loss reinsurance is likely to be required (1). Stop-loss reinsurance is less likely to be sought because of the reduced importance of point 2.

Points 3 and 4 are likely to result in the levels of retentions being lower than would otherwise be the case, and especially the ceding of more reinsurance on a proportional basis either by means of a surplus treaty, or facultatively.

The overall effect is designed to be protection of solvency and production of a steady flow of profit.

(iv)   The Practical Implications for an MAT Specialist

For an insurer writing MAT business it has to be borne in mind that
cover consists of two parts with rather different characteristics.

(a)   property risk which is relatively short-tailed but may involve
      very large sums insured.

(b)   liability risk which is long-tailed and can involve very large
      claims which are not usually quantifiable at the outset.

Also it has to be borne in mind that this class of business is generally
written on a line-slip basis, which is a form of co-insurance, so
that an individual insurer can control his maximum liability under
type (a) by restricting the line for which he is prepared to sign.
However, because of the size of the sums insured involved, and also the
existence of the unquantifiable liability risks, this restriction is
an imperfect way of controlling maximum claims pay-out, so reinsurance
is necessary for the purpose.

Thus the most important factors are:

1.   The extent to which the insurer is exposed to the possibility
     of catastrophe either through one substantial claim or an accumulation
     of losses from the same incident. The accumulation risk is extremely
     difficult to assess because of the mobility of the risks.

2.   The extent to which results are liable to fluctuate from year to
     year - MAT business tends to have a cyclical pattern dependant
     on the level of business activity in the Western world.

3.   The adequacy of the premium rates is likely to be important,
     especially in view of the fluctuating profitability referred to
     above, and the concentration on a single class of business.

     However, as for a specialist fire and accident company, reinsurance
     can only be considered a short-term measure in this respect,
     always assuming a relevant cover is available at all.

4.   The use of reinsurance to obtain geographical reciprocity has
     less application in an MAT account because the large, mobile
     risks involved give rise to a world-wide distribution of cover.

5.   The extent to which a suitable currency clause can be arranged
     will affect the choice of reinsurance programme. This needs
     to give adequate protection against the possibility of claims
     payments being in any currency, since MAT claims may be paid in
     any currency, not necessarily that in which the premium is due.

As a result of these factors, an MAT insurer will require a non-proportional
(excess of loss or catastrophe excess of loss) reinsurance treaty
to protect against the problems in paragraph 1, but this is often in
conjunction with surplus or quota-share to limit the premium ceded
to excess-of-loss reinsurers. Items 2 and 3 indicate the need for a
stop-loss treaty; but in general such cover is not available on
the market especially if premium rates are weak. As a result of 5
all treaties are likely to contain a currency clause.

(v) Practical Implications for a Reinsurance Company

For a reinsurer, the solvency aspects of reinsurance are the most important, especially those resulting from accumulation risks. These accumulation risks considerably complicate the problem for a reinsurer, because of the very much greater risk that a reinsurer will find that he has more of a particular claim, or greater exposure to the effects of a series of claims (e.g. arising in a particular geographical location from a particular natural hazard) than the reinsurance company retention. This greater risk arises because of one or more of the following possibilities:

1. Where the reinsurance company unknowingly receives a greater line than it really wants due to indexation, currency movements, a build-up of ancillary sections of the claim, etc.

2. Where the reinsurance company takes lines on the same risk from more than one direct insurer or other reinsurer.

3. A specific risk may be declared to a treaty where the risk is potentially greater than the reinsurance company retention.

4. Where the reinsurance company offers a greater line than it really wants to take, to provide a service, to obtain reciprocity or to get control of treaty terms.

In addition, other factors which affect the choice of programme are:-

5. The degree of confidence which the reinsurance company has in its acceptance. This can be prejudiced if they are dealing with a new company, a new territory or a new class of business.

6. The use of reinsurance for reciprocity purposes is widespread in the reinsurance market.

7. The extent to which the company can obtain an over-rider to retrocede business it does not really want, thus making a profit on expenses. Although this is considered bad practice, it undoubtedly does happen.

8. The extent to which the company reinsures specialist classes of business such as Hail.

9. The extent to which reinsurance is being used in conjunction with a fronting operation.

10. The nature of the company and its "implicit" capital backing. For example, it may be a State reinsurance company, or part of an international group of companies.

11. The quality of the prospective retrocessionaires.

12. The extent to which the local supervisor does or does not control the activities of reinsurance companies.

The above points may apply to either proportional or non-proportional reinsurance port folios. They will have the following practical effects on the company's retrocession programme.

Points 1, 2, 3 and 4 result in pressure on the solvency of the company, and require the inclusion of non-proportional protection in the company's retrocessions, although 3 and 4 may to some extent be offset by the inclusion of proportional reinsurance, especially quota share where reciprocity is involved.

Points 5 and 10 are only likely to affect the level of the reinsurance company's retention rather than the type of reinsurance it seeks. In the case of State or international group reinsurance companies, there may be some difficulty for a supervisor if no guarantee exists as to the provision of additional capital as necessary.

Points 6, 7 and 9 suggest the use of proportional reinsurance, particularly quota share, and in the case of 6 this may be on a 100% basis.

Point 8 may involve the inclusion of stop-loss reinsurance as this form of cover may be available (and considered desirable) for some of these specialist classes. However, the situation here is complicated by the fact that the reinsurer has a different spread of risk.

(a) Proportional Business

There do not appear to be any additional factors which need to be taken into account when retroceding proportional business.

(b) Non-Proportional Business

In addition to the above general points, the following will affect the reinsurance company only in respect of its non-proportional acceptances.

1. In relation to fire excess-of-loss, the company's retrocessions should take account of whether it is dealing with working layers or catastrophe layers.

    For the former, a surplus treaty is suggested, but in relation to the latter, especially taking into account geographical concentrations a layered excess-of-loss protection is almost certainly required, such that any one catastrophe is unlikely to hit the reinsurance company's free reserves by more than a known percentage.

2. In relation to accident excess-of-loss, accumulations are the over-riding factor, as discussed in an earlier section. Hence a layered excess-of-loss cover will be required, with a retention which allows a factor for the extent of the risk of unknown accumulations, on top of the provision for known accumulations which is, of course, much simpler.

(vi) The Effect of the Company's size

Whilst basically the same principles will affect the decision on
reinsurance policy irrespective of the size of the company, the
weights attached to these principles will vary according to such
factors as size of operations and comparative level of solvency margins.

Although many large composite companies have raised additional capital
over the last ten years t hrough rights issues, this channel of
improving solvency margins is not available to mutual companies and
probably less readily available to a smaller company. Hence these
groups may rely to a greater extent on the use of reinsurance to
finance premium growth. This suggests the greater use of quota
share by a small company.

Retentions for smaller companies are likely to be lower, in order
to provide the same measure of protection against insolvency. The
same may apply to a small account within a larger company, although
there is no real justification for this course.

In particular, small companies are likely to purchase working excess-
of-loss protection, whereas a larger company may protect itself
only against the major catastrophe.

If available, stop-loss cover would be likely to be of greater value
to a small company which is particularly vulnerable to an adverse
fluctuation in claims results.

SECTION C - THE LEVEL OF RETENTIONS

1.1 Setting a heading as level of retentions tends to imply that decisions
have been taken already as to the type of reinsurance to be employed.
In some cases the use of a particular type of cover is standard. However
for some types of portfolio it is usual for a combination of different
types of protection to be arranged, and there may even be a choice as
to which of the possible types will be most effective as alternatives
in a particular case. Such possibilities will obviously require more
detailed considerations, some of which cannot be readily expressed
quantitatively.

1.2 The three most obvious measurable quantities principally affected by
each reinsurance arrangement are (a) expected total retained claims
cost, (b) standard deviation of this expected value and (c) cost of
reinsurance. The amount which the insurer will pay for protection
will depend on the extent of his need for that cover. Thus to decide
on the type of reinsurance package covering all lines of business appropriate
in the special circumstances of a company will require an analysis
of the reasons, with priorities, for the protection (as discussed in
Section B above), and a full analysis of the effects of each available
type of package on the expected retained claims. Investigation is
obviously necessary into the current state of the reinsurance market
so that the costs of the various covers at various levels may be discovered.
Then a management decision must be taken as to the best way of balancing
requirements with available covers likely to provide the most desirable
types and levels of protection at acceptable costs.

1.3 It is impossible to give an in-depth discussion of the quantitative needs
of companies in specific circumstances in the limited space available
here, and pointless to try to give a brief generalisation. Also most
readers will already know the basic techniques required to obtain
estimates of expected total retained claims costs and the corresponding
standard deviations, given a suitable claims distribution function.
Most difficulties arise in (a) attempting to find a suitable function
which fits past data sufficiently and (b) adapting such a function
to allow for future inflation and changes in the account. As far as
the volume of data allows, business should be subdivided to try to
ensure homogenity as regards loss frequency and severity considerations.

2.1 There have been many papers published which discuss in comparatively
theoretical (rather than practical) fashion various aspects of the
application of various kinds of reinsurance (particularly excess of
loss) to specified types of portfolio. Some of these present particular
types of claim model for use in analyses. In the space available here
a full survey of the theories and methods discussed at length in such
papers is not possible or appropriate. However various aspects of
practical analyses must be commented upon.

2.2 This study group has had the benefit of a preview of Bob Alting Von Geusau's paper to the XVth ASTIN Collogium. In this he highlights several of the problems which arise in trying to get accurate practical and practicable analyses of reinsurance problems. In Section III he presents a forecasting model for Excess of Loss reinsurance.

3.1 In many ways XL appears to be the most amenable of the available reinsurance covers as regards mathematical analysis. It also seems to be the type most likely to be directly crucial to the solvency of many direct offices for the majority of types of business (subject to intelligent approaches to rating, underwriting etc.). However, as Bob says at the start of subsection III. 2 in his paper, it has been his experience (and that of others too!) that many past presentations of a classical approach to XL problems fail very early when application to reality is required - as they start by assuming a probability distribution of individual claim amount which can be easily manipulated mathematically. Elegant calculations of expected claims costs (and their variances) for direct writer and reinsurer can then be readily produced for various XL priority levels. However, it is by no means obvious that any such function is a sufficiently good fit for this type of problem. It is often impossible to find a single function which provides anything approaching a good fit to the entire loss distribution for a class of business, and so it is frequently necessary to use either a sum of functions (different terms predominating for different sections of the curve) or to accept that only a part of the curve will be fitted and analysed at a time. To justify such situations it is usually said that large losses are of a totally different basic nature to run-of-the-mill small losses. But how can we establish the balance between these in advance or even decide exactly where the dividing line is, if it exists? In any event the variation of past results in the tail of the claim size distribution frequently makes selection of parameters relating to that section controversial. To select an apparently reasonable function as an approximation to the claim size distribution may be useful to give rough estimates of the effects of various management decisions, but this can be dangerous if insufficient attention is paid to the size of possible errors, particularly in estimating variance of total loss, arising from poor fitting, especially in the extreme tail.

3.2 Bob not only attempts to build a model to reduce the effect of mathematical fitting, but also incorporates the fact that many settlements are made by a series of partial payments, which is especially important when the impact of inflation on claim costs is also introduced. It would be very difficult and indeed unfair to Bob to try to present a precis of his paper or even a full outline of his approach here. However, one further point is that there is obviously scope for an element of subjectivism in the choice of values to be used as frequencies for each model value in Bob's system, as is seen in his case study in III 7. There seems no way round this as we all lack basic"crystal-ball-gazing" ability (otherwise we could achieve better results by simpler means!)

However it is at this stage that advice from skilled underwriters and claims managers can and must be incorporated, and adjustments made for changes in legal liabilities, systems of court awards etc., as well as any changes in policy cover or types of risk covered in the account over the period of analysis and for future application.

3.3 Since premiums are not basically proportional for XL reinsurance the broad range of possible optional cover to be sought as a result of the analysis (of whatever form) of claims effect, and other considerations, is narrowed by the premiums charged by the reinsurers. Their opinion of appropriate charges will almost certainly differ from that of the cedant. The standing of the cedant in the market and the capacity of the reinsurance market itself often have a marked effect on the levels of rates quoted.

4.1 For property lines, the most important type of reinsurance protection necessary to protect solvency may often be an Aggregate Excess of Loss cover. Several classes of business including for example fire and motor and marine are liable to aggregations of losses within each class arising from one event, such as a very large storm. Aggregation between classes also occurs. The smooth flow of overall results could be seriously upset and solvency threatened unless suitable cover is obtained.

4.2 Probabilities of such major events are virtually incalculable over a short term, and even after careful research on volumes of business written in key exposed areas, it is very hard to estimate possible losses (net of reinsurances).

Some very rough calculations of parameters based on past events and frequencies of past occurrences can indicate the level of risks run by the direct writer. Quotations are likely to be sought for a wide range of layers of covers. Obviously small companies need cover at much lower levels than large ones but the principles to be considered would not be basically different.

4.3 Reinsurance companies and their reinsurers will be so far from the data on original risks covered that calculations will be even more approximate.

4.4 The final decision on precisely what level of retention to choose will probably depend greatly on the rates quoted for cover, although the level must be low enough to ensure solvency in the event of all "foreseeable" disasters at all costs.

5.1 Surplus reinsurance is also used to protect property lines, but any statistical analysis of appropriate levels of retention is subject to even greater problems than for XL. In practice most companies appear to use a complex system of varying maximum retentions by classification of risk within an account, often using an EML basis. (In many cases the SI is totally unrealistic, e.g. for measuring size of individual risks covered collectively under a blanket policy. However it must be noted that EMLs can also be unreliable since they are sometimes exceeded).

5.2 The mix of types and sizes of risks in the portfolio is critical to the variablility likely to be inherent in the total results. Overall loss frequencies and loss as percentage of SI (or EML) distributions vary considerably between various types of risk (and even sizes within risk categories). At times papers discussing overall loss frequencies and loss as percentage of SI have been produced using various assorted data. The manner in which such published data might be utilised when large commercial or industrial risks, where EML's rathers than SI's apply, are included in the account is not obvious. It seems improbable that there would be direct applicability in view of the difficulties of fixing appropriate risk size measurements where these are not specific.

5.3 This makes fixing parameters and constructing a simulation model of effects of surplus reinsurance almost impossible without assumptions and approximations, particularly as to roughly homogeneous groupings. To produce a model of the effects of various surplus reinsurance strategies, it would seem that each strategy should be specified in great detail at an early stage in the calculations, and this would make simulation of results highly cumbersome.

5.4 The maximum amount the company is willing to lose on any one risk obviously depends on the frequency of loss, distribution of losses up to that level and the stability required in the account. Within a narrow band the fringe terms offered by the reinsurer would decide the exact level selected.

5.5 Statistical theory would tend to lead to the adoption of one acceptable limit size per risk. This could be expressed in EML or SI terms. If the EML basis is used, some allowance (based on past experience, which may itself be unreliable) must be made for the chance that values are not in some cases actual maximum possible losses. In practice, underwriters frequently only hold full retentions agreed and cede the maximum allowed number of lines in respect of top quality risks. Own retentions and number of lines ceded are usually reduced (meaning lower original acceptance) on lower category risks. Suggested justification for this is that it is considered unwise to pass on too much risk in the categories where claim results are most variable and for which it is less easy to justify premiums as fully adequate; and random fluctuations of results could more easily lead to loss of goodwill, following the reinsurer being passed an unrepresentatively poor section of the direct writers portfolio for several years. This practice will tend to protect the solvency position of the insurer directly. It also complicates analysis of probable effects of changing the basic retention pattern for surplus cover since overall practice resulting from each pattern cannot readily be established.

6.1 If a suitable underlying distribution of losses is obtainable in any form, the analysis of the results of a quota share reinsurance can be made fairly straightforwardly, and premiums, expenses of operation and approximate commissions incorporated. Section V of Bob Alting von Geusau's paper deals with this problem.

7.1 In the Appendix to this Section an example of using a simple simulation model to indicate the effect of various reinsurance arrangements on solvency margins is presented.

APPENDIX TO SECTION C

Setting Retention Levels
By Simulation

As already discussed there are many reasons why an insurance
company should reinsure some part of its business. However, for
purely solvency reasons, it seems likely that the levels of
retention needed (other than for catastrophe cover) are much
higher than those currently used by insurance companies. This
appendix attempts to outline one simple theoretical method of
setting retention levels by simulation to ensure an acceptable
level of future solvency margins having regard only to reinsurance
policy.

When considering solely the amount of reinsurance necessary in
relation to the solvency margin held the management of a company
may well wish to limit the average amount by which the solvency
margin will change from year to year and to set a limit on the
probable maximum amount by which the solvency margin will change.
In statistical terms we want to limit to given amounts the mean
and standard deviation of the percentage changes in solvency
margin. As the trend is increasingly to quarterly accounting we
shall consider these amounts on a quarterly basis.

A computer program has been developed in conjunction with the
the Liability working party to simulate the experience of an
insurance company. The full details of the working of the program
are described in the report of the Liability working party. The
program has been modified to allow for the varioustypes of
reinsurance as follows:

Excess of Loss: Rather than generating the total claim distribution
each claim is individually generated so that it can be reduced
appropriately if it exceeds a particular excess of loss limit.
Thus a large number of claims are generated and this made the
running of the program on the mini-computer available very slow.
The generation of more than a few hundred claims per quarterly
period was therefore impractical. The premium and capital were
reduced in line with the reduction in the expected claim amount.

Stop Loss: This was simply allowed for by working with the total
claim amount distribution. For the purpose of illustration the
reinsurance is assumed to operate to cover all losses between 80%
and 140% of gross premium. As in excess of loss the premium and
capital was reduced to take account of the reduction in the
expected claim amount.

Quota Share: Essentially this is used to reduce the standard
deviation of the total claim amount (and perhaps also the amount
of business) and thus improve the solvency position. This can be
done using a reciprocal or a non-reciprocal treaty. The net account
(with its reduced standard deviation and original solvency margin)
is then subject to reinsurance as mentioned elsewhere. Allowance
for quota share reinsurance in the program was therefore not
considered.

<u>Surplus</u>: Surplus reinsurance could only be considered if a distribution of policies was assumed with suitable retention levels for each policy. While this is possible it would use a large amount of computer time which was unfortunately impractical on the machine available.

Assumptions

It is assumed throughout that a company will have catastrophe excess of loss cover to protect itself against a serious accumulation of claims. Net interest is taken as 1.75% per quarter (= 7.2% per annum) and inflation as 2.5% per quarter (= 10.4% per annum). All other variables in the program (eg changing inflation, inflation and interest cycles and run-off of claims) were not used as they complicated the results unnecessarily without adding anything particularly useful. The total level of commission and expenses was assumed to be about 30% of revenue premium.

The distribution of the gross individual claims was assumed to be log-normal with mean 100 and varying standard deviations; the number of claims was assumed to follow a Poisson distribution. For each standard deviation different retention levels were taken. In order to generate the claims the same set of random numbers was used so that comparative results were obtained.

The initial solvency margin was taken as 40%. This is important when considering the average percentage change in solvency margin as a higher initial level will give lower percentage changes in the solvency margin eg for an initial 80% solvency margin the percentage changes in solvency margin would be approximately half those given.

The standard deviation of claims in a portfolio will vary for a large number of reasons. However, as a rough guide, the individual claims in a portfolio might have the following standard deviations when standardised to an average claim of 100.

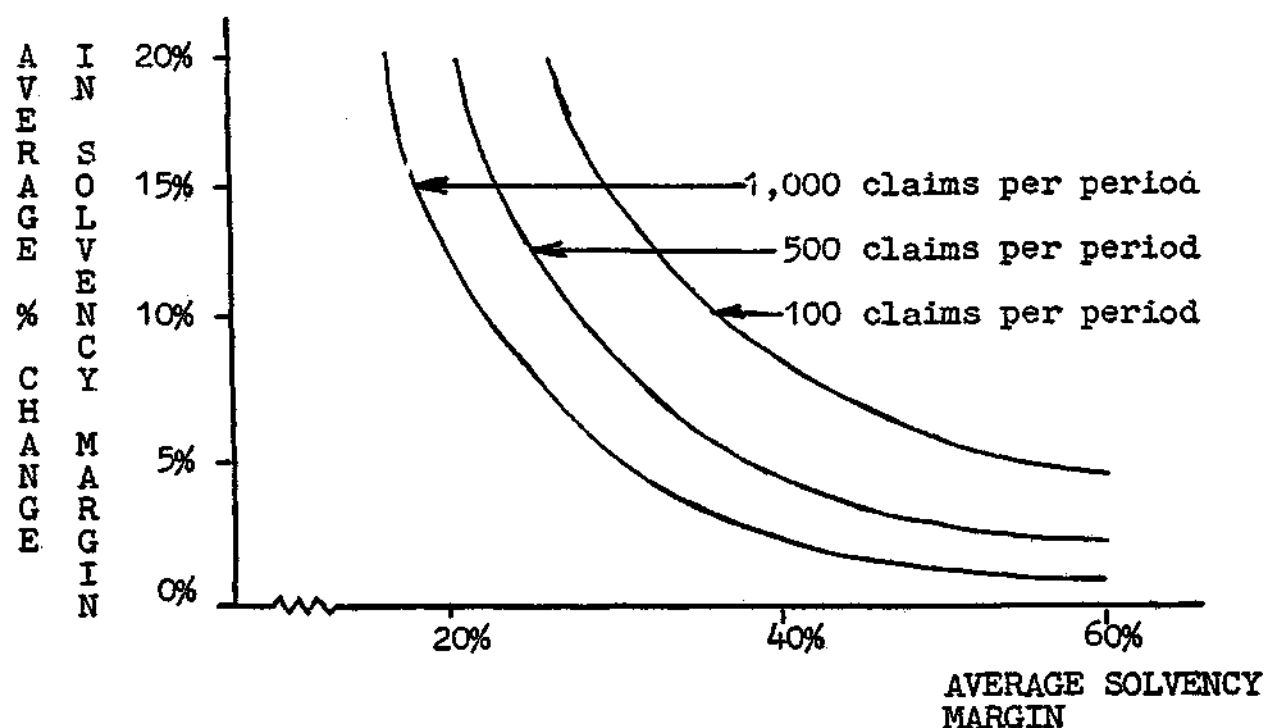| MEAN	STANDARD DEVIATION	TYPE OF ACCOUNT
100	200	Personal Accident
100	300	Domestic household
100	400	Motor
100	600	Commercial fire
100	1,000	Liability

Results

<u>Excess of Loss</u>: Using an average of 100 claims per quarterly period and the 'standard' set of random number the following results (showing the mean of the percentage change in solvency margin with its standard deviation in brackets) were obtained:

		LOGNORMAL DISTRIBUTION (OF INDIVIDUAL CLAIMS)		
		Mean = 100 SD = 200	Mean = 100 SD = 500	Mean = 100 SD = 1,000
R E T E N T I O N	200	3.8 (2.8)	4.1 (3.0)	4.3 (3.0)
	500	4.8 (3.3)	5.7 (3.8)	6.4 (4.1)
	1000	5.6 (3.4)	6.6 (4.0)	7.1 (4.5)
	∞	6.1 (4.2)	8.9 (7.2)	10.3 (8.9)

The size of the account considered here is fairly small. One would expect a larger account to show a lower average percentage change in solvency margin. In considering a larger account different sets of random numbers must be used which make the results not strictly comparable with those above. Also the results will depend on the solvency margin generated. However by making a number of different runs we can relate the average percentage change in solvency margin to the average solvency margin. For the distribution LN $(100,1000^2)$ and a retention of 1,000 the relationship is as follows:

Given graphs of the above form a company could determine its retention level given its size of account, its claim distribution, its level of solvency margin and the maximum percentage change in solvency margin desirable. As was to be expected it can be seen from the above graphs that excess of loss reinsurance (other than catastrophe cover) is virtually unnecessary (in terms of pure solvency considerations) for most UK companies. This follows because companies will normally have larger accounts and higher solvency margins than considered here. Thus the chance of their average percentage change in solvency margin being significant is very small, even with an extremely limited reinsurance program. This seems to trivialise the terms of reference given to this working party!

Stop Loss: The following table shows the smoothing effect of stop loss reinsurance for accounts of different sizes and different distributions:

| | | LOGNORMAL DISTRIBUTION (OF INDIVIDUAL CLAIMS) | | |
		MEAN = 100 SD = 200	MEAN = 100 SD = 500	MEAN = 100 SD = 1000
N U M B E R O F C L A I M S	P E R Q U A R T E R			
	100 – no R/I	8.4 (6.7)	16.2 (13.9)	20.1 (16.2)
	– with R/I	6.7 (4.9)	10.4 (7.6)	14.5 (10.8)
	1000 – no R/I	2.8 (2.2)	5.9 (4.7)	11.0 (9.0)
	– with R/I	2.7 (2.0)	5.1 (3.7)	7.7 (5.7)
	10000 – no R/I	0.9 (0.7)	1.9 (1.5)	3.8 (2.9)
	– with R/I	0.9 (0.7)	1.9 (1.5)	3.7 (2.7)

The figures are not directly comparable with those shown earlier as a different sized set of random numbers must be used.

Again a company could decide the level of reinsurance cover it needed given tables of the above form for various levels of cover. It can again be seen that with a medium sized account the need for reinsurance (for purely solvency reasons) is extremely limited.

Conclusion

There is scope for more work to be done on these lines. The combination of varying conditions (as in the Liability working party report) and of varying reinsurance retentions would give some interesting results. However this was not within the scope of either working party. If the program was transferred to a faster computer, excess of loss results for larger companies could more easily be obtained. Also the simulation of surplus reinsurance might be possible. The possibilities are endless (given sufficient time).