

**CAPITAL REQUIREMENTS
AND RISK-BASED CAPITAL**

Nigel Hooker (chairman)
Richard Bulmer
Susan Cooper
Peter Hinton
Andrew Newman
Tony Silverman
Walter Wright

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Summary

The paper looks at the problems of assessing the capital requirements of a non-life insurer from a regulator's viewpoint in the context of the United Kingdom. It considers how capital requirements might vary according to the different risks to which an insurer is subject and how this Risk-Based Capital (RBC) might be measured in practice.

Chapter A sets the scene by discussing insurer solvency and how to measure and compare the financial strength of insurance companies.

Chapter B looks at the considerations that an insurance regulator is faced with, including objectives, possible actions, desirable features of a solvency test, the stringency of solvency tests, and how public the results of such testing should be. A few brief remarks are made on the special features of Lloyd's that complicate the regulator's task.

Chapter C discusses various types of risk that an insurance business is subject to. It considers how these various risks interact and how an insurer can mitigate the effect of these risks in combination. There is a section on the miscellaneous factors that, while potentially significant, are difficult to measure in order to incorporate them into a mathematical formula.

Chapter D describes the US Risk-Based Capital system, including the formula itself with examples to illustrate its operation. Some results of testing are given, and a series of our comments and criticisms are included.

Chapter E closes the paper by outlining how a Risk-Based Capital formula could be constructed for the UK, but the difficulty of preparing a formula is acknowledged.

Chapter A : Background

Introduction

Risk-Based Capital is a comparative measure of the capital required to support an insurance company. RBC is the amount of capital that is needed to absorb, to the desired extent, the risks that can be anticipated in the operation of an insurance business. In this paper Risk Based Capital is investigated as a way of measuring solvency and is offered for discussion by the profession and with regulatory authorities. The UK, along with the rest of the European Union, is committed to reviewing the EC solvency margin requirements with a view to considering whether or not any change is required in the laws.

On 28 June 1993, the USA the regulatory authority, the National Association of Insurance Commissioners (NAIC), issued an exposure draft of a Risk-Based Capital formula considered suitable for use with property-casualty insurance companies. The regulators of banking and savings institutions and life and health insurance companies in the USA and elsewhere have already started to use a Risk-Based Capital element among the set of supervisory ratios used to assess capital solvency. There have been updates to the NAIC exposure draft and a definitive instruction package is expected to be released by the NAIC this Summer (1994).

Capital Adequacy Measurement

This paper discusses the characteristics of a function $f(x,y,z,...) = c$ (where $x,y,z,...$ are measures of risk and c is an amount of capital) to produce a consistent standard of capital adequacy. Such a function maps out the contour lines of capital adequacy on the landscape of insurance companies; the aim of the regulators is to establish a high water mark which in the normal course of events will not be breached. Just as important centres of population may be protected by superior flood defences, so a good regulatory regime should discourage insurers from living close to the edge.

Questions are raised about elements of this function: What are the factors measured by x, y, z, \dots ? How should these factors be measured? How should the function f respond to each factor (keeping the others fixed)? What are the interactions between factors and what are the implications of these for their effects on f ?

We also need to ask what we mean by capital? Is it simply assets minus liabilities or should some allowance be made for working capital requirements (i.e. the ability to fund cash flows)? How should capital requirements reflect margins in the measurement of assets or liabilities? A business not only needs to know that its total reserves are adequate, it also needs to be assured that its reserves are available when they are required, and so the relationship between the timing of the asset receipts and the likely timing of the liability outgo is also a very important measure. This cannot be adequately measured by Risk-Based Capital. Thus there is a need to look at a company on a dynamic basis whereas Risk-Based Capital is essentially looking at the company on a static basis.

Insurer Solvency Issues

Claims paying ability is of paramount importance for any insurance company. For a non-life insurer, it is largely dependent on the overall amount of available assets in relation to the overall amount of liabilities. It does not solely depend on the adequacy of the technical provisions, nor solely on the capital and reserves (or 'surplus') of the insurer. Prudential margins in the technical provisions may be incorporated in equalisation reserves, provisions for adverse deviations, undiscounted reserves, and so on, rather than (or in conjunction with) the margin of solvency (including both the statutory minimum margin and the remaining net assets or shareholders' funds).

Insurer insolvency is not only the concern of the existing or potential future policyholder, or of the regulator on behalf of the policyholder. Shareholders cannot realise their desired return on insurance company investments unless the company continues to meet its obligations to policyholders. There is however a conflict between adequacy of capital

and return on that capital. The insurance industry itself is damaged by failures of insurance companies, since they undermine the trust of the customers and potential customers which is necessary in the financial service being provided. However, is it a case of insufficient capital in the industry as a whole or simply that there have been a few undercapitalised companies? Insurance industry analysts recognise these considerations but tend to look at the industry's overall position. Insurer rating agencies are also concerned with different means of assessing claims paying ability but concentrate on individual companies not industry aggregates.

It is almost axiomatic that to continue to be solvent (in the sense of being able to meet obligations as they fall due) a non-life insurer has to (a) charge and receive, (b) retain as reserves, and (c) invest prudently sufficient premium income to cover the ultimate cost of claims and expenses arising from business written, and to manage its accumulations of risk by limiting its concentrations of exposure or transferring the risk effectively to alternative solvent risk carriers. Actuaries can (and increasingly do) have an important role to play in each of these aspects. However, we do not have a monopoly of relevant expertise and there are lessons to be learned from the experience in the USA in terms of the role of actuaries within both the Property/Casualty and Life/Health industries.

Disclaimer

Any opinions expressed in this paper do not necessarily reflect the views of all members of the working party, or of any organisation with which they are or have been associated.

Chapter B : The Regulator's Perspective

Regulator's Objectives

Adequate capital is important but is only one of the regulator's objectives. Others include fitness of management and the adequacy and suitability of reinsurance.

The regulator requires a decision rule that is objective and consistent for

- (a) when to examine a company more closely
- (b) when to take action against a company
- (c) what action to take.

Any formula is imperfect, since events are not entirely deterministic. As a statistical test, therefore, any decision rule will be prone to type 1 errors (i.e. failure to spot or intervene in a troubled company) and type 2 errors (i.e. unnecessary work or intervention).

Generally type 2 is regarded as less serious than type 1 since the prime aim is to protect insureds against potential insolvency. But type 2 errors are undesirable, as they create

- for the regulator, a diversion of resources, leading to genuinely troubled companies not being dealt with, and over-costly supervision;
- for the owners of the insurance companies concerned, wrongful loss of trade, which may lead to legal actions against the supervisor; and
- for the consumer, increased cost of insurance and a weakened perception of the market.

The regulator's priorities should therefore be to minimise, or at least limit to an 'acceptable' level:

- the number of insolvencies
- the number of people affected
- the cost of insolvencies
- the predictable or anticipatable insolvencies
- the cost of actions to restrict insolvencies

However, the regulator needs to bear in mind:

- Regulatory arbitrage - i.e. if the RBC is thought to be unsound or too strong, will customers go elsewhere?
- What is the comparative frequency and severity of insolvencies between the UK and, say, the US?
- Will the RBC value be considered a measure of strength and is this desirable?
- The RBC formula needs to be considered carefully. It should not lead to behavioural change, unless that change is desirable. For example, in the US the RBC formula penalises companies which have strengthened their reserves irrespective of the circumstances.
- RBC could be considered only one of a range of tools available.
- RBC may be better at measuring stochastic risks than other business risks.
- Insurance takes on risks different from those taken on by banks.
- Even good managements get things wrong occasionally, so there is always a degree of normal management risk, but in addition there is a risk of a complete management breakdown in which there is no limit to how wrong things can go.

Desirable Features of an RBC Formula

The formula needs to be:

- as accurate as possible (but, regulator and others should remember, imperfect)
 - understandable
 - easy to calculate
 - robust
 - based on information already supplied to regulator (e.g. via the DTI returns)
 - commanding general support
 - not likely to cause much undesirable behavioural change
 - reflecting public priorities,
- although these features are to some extent conflicting.

'Robustness' means that trivial changes to circumstances or data should not change capital requirement significantly, thus making it difficult for companies to manipulate their RBC requirements. The formula should enable the regulator to see through window-dressing, such as well timed disposals of inadmissible assets. This could be achieved through a requirement for the company to maintain its RBC at all times and to certify that it has done so, but this would be difficult to enforce and may effectively increase the RBC requirement. Alternatively, there could be penalties for falling below a proportion of the RBC on an instantaneous basis. Or the company could be required to notify the supervisor as soon as it becomes apparent that RBC was or is not covered.

'Reflection of public priorities' means that, since the regulator is a public servant, it is only right that his or her actions should reflect these priorities. For example, more attention would be paid to companies writing personal lines than might be justified by their position in the economy. In practice, these political requirements would be manifested as a desire to avoid embarrassment.

A battery of tests may cope with diversity better than a formula. But a precise, single-figure formula may be more efficacious at enabling the regulator to intervene.

A flexible formula may enable a better response to changing situations than a fixed one, but this then poses the problems of who should keep the formula up to date and what time scale should reviews be subject to.

Not all financially significant factors can be included in a formula. The decision what to include is a pragmatic one. Ad hoc private adjustments may be applied by the regulator for other factors.

Regulator's Action

Action by regulator can include:

- (a) faster examination of the company's information
- (b) more detailed examination of information available
- (c) asking the company for additional information

- (d) requiring the company to prepare a plan for the restoration of a sound financial position
- (e) requiring the company to take specific actions
- (f) direct intervention in the affairs of the company
- (g) winding up the company

(a) and (b) are internal, therefore there is no need to justify them to others (except possibly after a company has got into trouble)

(c) requires little justification providing that the information is confined to what the company has readily available. If gathering the information involves the company in significant expense (e.g. obtaining an actuarial report which management does not consider necessary for the routine conduct of the business) then the regulator may have to justify this requirement to the company

(d) requires some sort of trigger. If the plan is unsatisfactory, delayed, not implemented or fails, further intervention will be needed.

(e) and (f) may need to be justified to the company, who can seek a judicial review (at least in countries subject to the rule of law).

(g) will need to be justified to the Courts on grounds of insolvency or public interest.

How Tough Should the RBC Formula Be?

With a strong formula the regulator would need discretion *not* to intervene at the specified action levels if, in particular circumstances, the formula is too harsh. Notwithstanding this, failure to meet formula is likely to be regarded by the Courts as justifying intervention, even if circumstances might be thought to permit discretion.

With a weak formula (e.g. EC required minimum margin) the regulator needs power to intervene on grounds of financial weakness in particular circumstances, even though the statutory margin may be covered. Intervention may be allowed or mandated on other grounds also, including the protection of policyholders. Alternatively different actions may be mandated at different levels. See Chapter D for US practice. Under EC legislation there is a requirement to submit a short term financial plan (in

practice to inject cash quickly) if the solvency margin is seriously impaired, but greater flexibility is available if the impairment is marginal.

Action by the regulator can include informal requests and hints to management. If this has statutory backing, the company knows that the regulator can enforce requests or impose more draconian measures, so this can be very effective and flexible, leaving formal enforcement as a last resort. The mere indication that regulator is taking an interest can have an effect.

For most companies the greatest risks relate to potential mismanagement. There are exceptions, e.g. companies writing high risk business (such as catastrophe business or US liability) or making high risk investments as a matter of policy (such as equities). Much of the mismanagement risk can be related to the specifics of the business (e.g. risk of getting motor rates wrong despite the evidence). From outside (e.g. regulator or policyholder) the scope for mismanagement is greater than apparent from inside. The regulator will therefore often need to impose greater capital requirements than the company considers necessary. When the regulator has specific doubts about the ability of management an ad hoc adjustment could be made to the formula to determine whether to intervene.

Should the RBC Results be Published?

Any RBC formula which mandates or permits specific action by the regulator will be in the public domain. It is not obvious why the results of this should be confidential. If the company is given a concession in respect of its RBC requirement, that can be public also (with an explanation).

An RBC formula used to determine the regulator's *internal* priorities need not necessarily be made public. An undisclosed formula does not give rise to undesirable behavioural changes. However, in time a formula is likely to become known. So secrecy is only useful for a formula under development. The formula may depend on 'soft' information which may be difficult to publish (e.g. spent criminal convictions of top management that are not sufficiently serious to render them unfit).

A public formula gives rise to behavioural change. Publicity for a soundly based formula is therefore good.

Perspectives on Lloyd's

Lloyd's is regulated differently from insurance companies. The Policyholders' Protection Act does not apply to business written at Lloyd's and the solvency requirements need to reflect Lloyd's matrix structure, with security being provided by Names (representing one dimension of the matrix) who have varying participations across the various syndicates (representing the second dimension).

Capital requirements could in theory be imposed at global, syndicate, or Name levels. Global requirements would relate to the adequacy of the Central Fund to pay all valid claims. Name-level requirements would relate to the solvency of individual Names. We understand that Lloyd's is considering this area. Syndicate-level requirements would only be used as an intermediate step in assessing Name-level requirements.

There are at present no explicit DTI capital requirements at Name or syndicate level. The DTI is interested in *global* not Name-level capital adequacy, and Lloyd's global returns must satisfy the DTI in terms of having both technical reserves and an appropriate solvency margin. However, global figures do not net off intra-Lloyd's reinsurance and thus increase the required solvency margin. The 'statutory minimum' solvency margin is covered by earmarked assets, although there is further reliance on other assets which provide an aura of hidden strength.

At the syndicate level, Names must satisfy capital adequacy requirements set by Lloyd's and these requirements have to be approved by the DTI. These requirements are expressed in terms of minimum reserves - there is no solvency margin as such. Historically the minimum amounts had to be the higher of 'Test 1' percentages and 'Test 2' estimates, but now actuarial certification, on a prudent basis and subject to the DTI's approval of the actuarial profession's guidance note, can be used to justify reductions in reserves if the Test 1 percentages are unduly conservative. These

minimum reserves are expressed in terms of premium income, subject to a minimum of any reinsurance to close. Additionally underwriting is restricted by reference to a Name's means. As a way of ensuring sufficient assets to cover losses on future underwriting, this is arguably better than a retrospective solvency margin requirement.

It is debatable whether, politically, the regulator should be more concerned with capital adequacy for personal lines syndicates than commercial, on the grounds that corporate policyholders are more sophisticated buyers and the larger ones at least have an opportunity to diversify their exposure to insurers that is not available to private policyholders. However, this would be difficult to apply in practice since a Name would belong to a spread of different types of syndicates and it would require a consensus on which business merited additional protection.

A Name's reserve in respect of Syndicate XYZ is the Name's proportion of Syndicate XYZ's minimum reserves. A Name's overall reserve is the sum of that Name's reserves across syndicates. However, there would be scope for applying a 'covariance factor' to reduce the Name's overall reserve below the simple sum of that Name's reserves across syndicates. However the interaction between syndicates is difficult to assess, making such a covariance adjustment problematical.

Chapter C : Types of Insurance Risk

Introduction

This chapter provides a discussion of the various types of risk affecting insurers that may be susceptible to treatment in a RBC formula. It also includes some comments on risks that would be difficult to measure and incorporate in a formula.

First we define two terms:

- solvency margin - the value of assets less the value of the liabilities. In practice, insurance regulators commonly establish rules that specify the minimum solvency margin for an individual company. These rules are typically based on somewhat simple factors, such as the overall amount of premiums.
- Risk-Based Capital - a minimum amount of the solvency margin as established in accordance with rules that are relatively responsive to the actual risk characteristics of the individual insurer.

We now turn to a discussion of risks affecting insurance.

Insurance Business Risk vs. General Business Risk

Why establish minimum solvency margins for insurance companies?

All business is subject to risk, which can be defined as the possibility that events will not go according to plan. Yet for most businesses, it has not been deemed necessary for regulatory bodies to insist on a minimum solvency margin. A major reason that this is required of insurance businesses is that insurers are regarded as trustees for what is in effect policyholders' money, whereas in many other businesses the goods or services are delivered either in advance of or very soon after the consideration is paid. In other words, 'trust me' is a major element of what

the insurer is selling. Policyholders stakes have been compared to debtholders' (see Bride and Lomax) but without the covenants that are common with loans keeping the management on the straight and narrow.

Given that insurance regulators require a minimum solvency margin, for whatever reason, what are the risks to which an insurance business is subject and which should therefore be taken into account by such a minimum solvency margin ? Other authors have identified lists of these risks (see for example '*Solvency of Insurers and Equalisation Reserves*', ed. Pentikainen and also the Institute of Actuaries Guidance Note 'GN12' Paragraphs 4.1 and 4.2). We have attempted to compile as complete a list as possible, but inevitably we will not have identified every risk possible.

Uncertainty of Claim Costs

According to Classical Risk Theory, the insurance claim process can be described by a probabilistic model involving a random number of claims and a random amount of each claim. These claims can be subject to adjustments due to policy limits and excesses, but in principle if one knows the underlying model precisely one can predict the statistical frequency of the various possible aggregate loss amounts, and the timing of their payment, to any required degree of accuracy. This should tell everything there is to know about the prospective claims experience. This gives the *process risk*.

Unfortunately, things are not that simple. The underlying model (if one exists at all) is unknown, and the only information that can be gained about it is by observing the random results it has thrown up in the past. Given a probabilistic structure for claim numbers and amounts and for the payout pattern, the parameters which describe this structure can be measured, subject to a confidence (or uncertainty) level which depends on the volume of relevant past observations. The risk that these estimates will not be exactly equal to the 'true' parameters is the *parameter risk*.

In addition there is the risk that the selected model structure is not the right one. Alternative model structures can be proposed which will yield alternative results for the aggregate loss amount distribution, and statistical

tests could be devised for choosing between alternatives on a rational basis, but again this is subject to uncertainty. This is the *specification risk*.

The uncertainty in claim costs, including claims handling expenses, applies both to reserves for claims on business already written and to the profits or losses expected from business yet to be written. To some extent, under-reserving for past business is likely to be associated with underestimation of required premium levels on future business. Both of these may be mitigated to some degree by appropriate professional advice.

Lines of Business

The insurance risk is dependent on the lines of business written by the company.

Different lines of business have different risk characteristics and may be, to some extent, independent or at least only partially correlated. Significant differences are found between direct and reinsurance business. The DTI accounting classes are inadequate to measure the significant differences in type of business, while risk groups are not standardised and depend on a company's own classification system.

Appendix 1 contains a list compiled by the DTI of the risk groups for UK insurance companies, as used in their DTI returns. The DTI regulations for risk groups leave much to the discretion of the company, the major exception being that since 1981 private motor business must be segregated into comprehensive and non-comprehensive. The DTI list therefore should not be regarded as best or recommended practice.

The EC authorisation classes provides a more detailed classification than accounting classes, but unfortunately are also not sufficient for a detailed examination of risk. For example, 'ships' business can consist of hull or liability or both. Also many contracts include elements from several authorisation classes, for example 'package' policies contain both first party and third party coverages, which are not easy to allocate between classes, and indeed may be allocated to a single class.

Trends and Cycles

Trends and cycles contribute to the overall insurance risk.

The perils which give rise to insurance claims and the forces behind them are not static but change over time. The nature of liability claims changes because of developments in legal theory and 'judicial drift'. The effect of these changes may be retrospective as well as prospective. The nature of property claims changes because of technological developments. These and other types of claim may also be affected by changes in the social, economic, or political environment.

Changes can be exhibited as trends or cycles. 'Trends', including one-time changes, such as inflation, usually include a notion of one-way traffic (in other words, irreversibility at least over the medium to long term even if not indefinitely). By contrast 'cycles' suggest movements which move in either direction with some degree of regularity, returning to the mean but with a tendency to overshoot.

It is important to distinguish between insurance cycles and economic cycles. The insurance cycle is the phenomenon brought about by

- the frequent failure (for whatever reason) of insurance companies to charge premiums that are suitable (i.e. neither inadequate nor excessive); combined with
- the relatively free markets in which insurance companies normally operate (in other words where both access to the market and pricing policy are subject to only limited constraints).

An economic cycle is a more general phenomenon the causes of which are beyond the scope of this paper. While an economic downturn is often thought to increase the frequency and/or severity of certain claims, those of other claims may be reduced, and the insurance *pricing* cycle does not necessarily operate in parallel to the economic cycle.

Insurers have in effect a dilemma: to ride the insurance cycle and risk a serious crash, or to get off and risk being left behind. The importance of

trends and cycles as regards insurance capital adequacy is that an insurance business should be able to survive a period of under-pricing (either deliberate or accidental) due to competitive pressures, and also should be able to withstand under-estimation of costs due to misreading secular changes or failing to anticipate extraordinary changes.

Inflation and Currencies

Inflation and currency mismatch increase the overall insurance risk.

Inflation, the persistent tendency of the prices of goods and services to rise over time, is a phenomenon experienced in capitalist and mixed economies. In non-market economies its equivalent is rationing by shortages rather than by price. We have already mentioned it above, as a trend. However, 'unexpected' inflation due to economic shocks are particularly serious risks since insurance premiums are set in today's currency while claims fall due in tomorrow's. It is however a long term or chronic risk, in the sense that prices and inflationary expectations do not usually change dramatically overnight.

An analogous risk is the mismatching of premiums and claims by monetary currency, which is sometimes unavoidable. Even so-called 'aligned currencies', such as those within the European Exchange Rate Mechanism, can move relative to one another by substantial amounts. This is a short term or acute risk, since currency movements can be very dramatic and can take place in a period of minutes.

Many believe that there is a link in the longer term between inflation, currency exchange rates, and interest rates. Some hedging instruments are available to reduce the exchange rate risk by making use of this long term link. However these cannot always be relied on, especially in currencies whose countries do not have a well developed and efficient capital market or where there are barriers to the free movement of capital.

Assets and Matching

The investment of assets, even in the form of cash, is subject to risk, because there is no investment that can be used to precisely match assets with insurance liabilities.

In the period between receipt of premiums and payment of claims, the insurance business has to decide what to do with the money. It will likely decide to make investments. However the aggregate cash flow is rarely allocated to specific policies, and there may be extended periods when the aggregate cash flow is negative, during which times the business is a net disinvestor. This would normally be the case if the insurer ceased for any reason to write new business.

The performance of the investments is a variable factor, and the various risks are different according to the nature of the asset. There is a degree of trade-off between risk and return. Two different aspects of the risk are interest-rate (or income) risk and asset-value risk. Interest rate risk may persist for an extended period of time, affecting cash flows. Asset value risk includes both permanent diminution in the value of an asset and temporary changes in its market value. Temporary changes matter if investments need to be realised at a time other than that which was planned or there is deliberate mismatching of assets and liabilities.

Mismatching risk arises essentially because of differences between the asset and liability portfolios in their nature, terms and currency. Even if income and capital values meet the exact payouts estimated, differences in currency of the assets and liabilities could give rise to losses.

Thus total asset risk can be thought of as comprising income risk, capital value risk, and mismatching risk.

The mix of the investment portfolio will be important in minimising concentration of risk in absolute financial terms. This may mean limiting the total investments in a particular company or type of asset. Related to this, the correlation in performance of various types of assets held is

important. This correlation may arise for many reasons (e.g. economic, concentration by location).

The main areas which need to be considered are the concentration of investment in certain types of asset and the size of total investment in one area (e.g. particular company or geographical area).

Run Off

The potential that an insurance company may at some time cease underwriting creates additional risk factors. Run off is an extreme case of fluctuation in business volumes, so these factors may also apply (possibly to a lesser degree) in any situation where there is uncertainty about future business volumes (i.e. the entire insurance market).

Usually an insurance business will be run as a going concern. A discontinuance of underwriting will emphasise certain risks and expose new ones. For example:

- The technical reserves may prove to be inadequate. This is equally possible for a company continuing to write business, but it may not be apparent to the outside world until after the company has recovered.
- The company may find itself subject to selective cancellation of policies, possibly mitigated by onerous short term rates that it can impose on policyholders.
- Non-renewal of certain types of policy may trigger onerous extended coverage or reporting provisions for little or no additional premium.
- Overhead expenses may rise relative to the amount of claims being handled, both in the immediate term before appropriate staffing levels have been established and in the longer term because of diseconomies of scale.
- Direct claims costs may rise owing to a reduction in control as the more competent and ambitious staff leave for more rewarding jobs and goodwill is lost, and this effect is likely to persist.
- Outward reinsurance costs may rise owing to the mismatch between the accident period basis of cover and the underwriting period nature of risks written.

- The expected reinsurance recoveries may be reduced as the reinsurers delay payment or exercise any rights of offset, control is lost over identification of potential recoveries, and brokers become slower in recovering funds.
- Cash flows are likely to become negative, forcing the realisation of assets.
- The realisable (economic) values of some other assets may prove to be lower than the accounting values.

There may be benefits of going into run-off, such as the possibility of being able to agree commutations on favourable terms (though this is not a benefit to the policyholders whose policies are commuted) and the inability of the company to write further loss-making business. However, all things considered, there are probably additional costs involved in going into run-off. RBC should allow for these extra costs to the extent that they are not already provided for in any technical provision.

Catastrophe Exposures

The insurance risk is dependent on the exposure to catastrophic losses. While this can be thought of as an application of risk theory to non-independent risks, the accumulation of risk highlights certain issues.

Certain insurable interests, such as North Sea platforms, are large enough in themselves to present the potential for a catastrophic loss.

Certain perils, either natural or economic, can give rise to a number of claims arising from a single 'event'. The catastrophic potential of windstorms, earthquakes, and floods, for example, are well known. Similarly economic events have catastrophic potential: for example a decline in economic conditions can give rise to a large number of claims from different coverages, such as mortgage indemnity guarantee claims, redundancy insurance claims, and theft claims, as well as fraudulent claims of various types.

Judicial, legislative and regulatory decisions can also have a catastrophic impact. For example, the US Superfund (pollution) legislation created a

huge (and retrospective) liability resulting in a large number of claims. The introduction of strict liability for pollution in Europe may have a similar impact.

The link between all these is the happening of a single 'event' and an aggregation (or clash) of coverages. The factors which affect how an insurance business will be impacted by such a single event include its limits of coverage aggregated over discrete, independent policy groupings, and its reinsurance protection (subject to the security of its reinsurers).

Credit Risk

In many respects insurance companies are no different to all other companies in that they rely on utilising capital to conduct business to meet certain objectives (often profit). As all operate in the same economic, fiscal and legislative arena, there are many credit risks which are non-insurance related (e.g. fraud and poor management) which may apply to all types of normal company assets. The data for measuring this risk is therefore wider than just the insurance industry.

The insurance business gives rise to certain specialised classes of debtors:

- *Brokers' and agents' balances*, which can be split into further sub-categories (e.g. balances in respect of normal insurance brokers and those held by building societies and banks where they act as brokers). The nature of these organisations and how they themselves are regulated have an impact on the default risk.
- *Reinsurers* accept funds and act as long-term debtors until claims occur such that the reinsurance payment is triggered. There are two main areas where reinsurers' credit risk needs to be assessed, namely
 - in the long term, how likely or able is the reinsurer to be able to meet the future cost of such claims?
 - how promptly etc. will the reinsurer pay those recoveries currently outstanding?

The question of correlation with insurance activities is important as reinsurers are likely to be least well able to pay claims at the bottom of the

underwriting cycle. For example, larger claims may mean both difficulties for reinsurers and large claims from elsewhere too.

Covariance

In addition to various balance sheet items and their susceptibility to individual perils, there is also the inter-relationship between items and between perils, leading to the notion of 'covariance', i.e. the degree to which factors move together rather than separately. The term 'contravariance' should perhaps be used in this context since the issue is to what extent the downside of one risk may be offset by the upside of another.

The concept of covariance applies to the interrelationship between lines of business, between past and future business, and between asset and liability values (provided these are well matched).

Mitigation of Insurance Risk

Possible actions which may be taken by management to mitigate the inherent risk of an insurance enterprise are:

- Avoiding an undue concentration of risk: in business written, in invested assets, in reinsurance ceded
- Diversifying by obtaining exposure to areas with different risk characteristics. This principle is applicable to business written, invested assets and reinsurance, and includes diversification by: country/economy, currency, industry, class of business written, types of assets (e.g. bonds equities), types of reinsurance (e.g. proportional, non-proportional), and size of company
- Reducing the impact of risk by proportional or non-proportional (or possibly financial) reinsurance; hedging investment portfolio using options, futures, other derivative instruments); matching assets and liabilities by currency, term, broad category of asset, and cash flows.

Miscellaneous Factors (or why RBC is not the total answer)

In this section, we describe those factors that are likely to be relevant to capital adequacy but that are difficult to measure or incorporate in a formula.

- **Size and Growth**

'Small' companies tend to be viewed as riskier, but this is not necessarily so. With size there can be economies of scale. But while a large company may have diversified into a large number of different lines of business, it is not necessarily less risky than a company specialising in a single line. It may be more difficult to manage a diverse portfolio than a single line that the company understands well, and the difficulty of managing disparate activities may increase the correlations between risks. Should this be taken into account or some flexibility given to regulators in interpreting RBC?

Rapidly-growing companies are also viewed as riskier. But growth needs to be considered in the context of inflation and looking at each line of business separately, trying to identify the causes of abnormally high growth. There are problems in starting out in a new direction or expanding rapidly in a given area. A company may recruit an 'expert', but that person may have had close management control or support not available in their new situation. Abnormally low growth or even reductions in size could equally be a signal of problems to come.

In their paper to the Casualty Actuarial Society, Redman and Scudellari examined a number of reports concerning the causes of insolvency in the United States. Rate of growth proved a significant factor associated with insolvencies. Size as such was not found to be an important factor.

- **Ownership and Corporate Structure**

There is a variety of different ownership and structural arrangements that can be made.

- Ownership can be Mutual, Limited by Guarantee, Shareholders, Captives. Mutuals cannot raise further capital. A company with shareholders can raise capital if it is believed that the company has value.
- Legal Structures can be as an Insurance Company only, as a Holding Company with insurance and service subsidiaries.

Relevant factors to consider relating to the structure are:

- How is the holding company financed?
- How is any borrowing financed?
- Are there guarantees between companies in the group or with third parties (such as a guarantee from a former owner of the business or a guarantee to the new owner of a divested part of the business)?
- How would a third party find out about such an onerous guarantee?
- A parent company may give a guarantee, but how much weight should be given to it?
- A guarantee may be subsidiary to the guarantee required in a run-off situation.
- Are there other financial arrangements that affect the insurance company?
- What is the quality of management in the service company?
- How will any problems in the service company affect the running of the insurance company?
- A parent may not be regulated.
- Accounts can be relied on to a greater extent in some territories than in others.
- Reserves may tend to be weak in some territories and strong in others.

As an example of the last point, discounting is prohibited in EC except if the run-off is four years or longer. Not discounting builds in a margin (although not necessarily an appropriate one). However, if discounting were to take place, more careful consideration may well be made about the margins required. Also in Canada there is now a provision for adverse deviation. Any such provision, and any equalisation reserve, should be outside the RBC calculation and offset against the RBC.

- **Management Structure and Quality**

The Third Non-Life Directive has a criterion for sound and prudent management, although this is largely undefined. According to UK legislation, a manager should be 'fit and proper' but this is not the same thing. Management competence is a 'soft' issue that RBC formulae would not readily be able to deal with. What soft data could be used? The history of individual managers may be relevant but it is difficult to see how to score this on a numerical scale.

Adaptability and short reaction time to adverse trends can mitigate insurance risk, but it may not be easy to incorporate into an RBC formula. Also adaptability can only be assessed in hindsight and it may well be the unforeseen that causes problems.

The management may be centralised or decentralised, with implications for control and speed of reaction. The control of underwriting may be in-house or exercised through agencies. In the latter case, the management structure and quality of the agencies needs to be considered.

The adequacy of human resources is important e.g. the number and quality of claims adjusters dealing with claims and underwriters dealing with incoming risks. The adequacy and quality of management information and IT resources is also relevant. The adequacy and quality of investment skills are important as is the rate of change.

The degree of independence and supervisory control exercised by the main board is likely to be particularly pertinent.

Chapter D : Description and Critique of US System

Introduction

The US insurance market has recently introduced a Risk-Based Capital system, and this section of the paper contains a brief description and critique of the US Risk-Based Capital formula for property and casualty insurers. Throughout this section, we have assumed the reader is familiar with the state-by-state basis of insurance regulation in the USA. The details in this section are based on the exposure draft dated 28 June issued by the NAIC. They are likely to be updated, possibly substantially, by the definitive instruction package expected to be issued by the NAIC this Summer.

Action Levels

The US RBC formula is used to determine the 'authorised control level' for each insurer. The company and/or the regulatory authorities may then take various actions, depending on the level of the company's free capital relative to the authorised control level. The thresholds for different types of action are as follows:

- **Company Action Level (2 x Authorised Control Level)**

The insurer must submit a plan containing, among other things, corrective action.

- **Regulatory Action Level (1.5 x Authorised Control Level)**

The company must submit a plan as in the 'Company Action Level'. The Commissioner will perform an examination or other analysis and, based upon such examination or analysis, issue a corrective order.

- **Authorised Control Level**

The same actions taken under 'Regulatory Control Level' shall occur. In addition, the Commissioner *may* take action to rehabilitate or liquidate the insurer.

- **Mandatory Control Level (0.7 x Authorised Control Level)**

The Commissioner *must* rehabilitate or liquidate the insurer.

These actions may be regarded as being quite rigid in that they give a relatively small amount of discretion to the regulator. Also, it could be argued that the policyholders are disadvantaged if they are required to pay additional premiums to service additional capital. However, this can be disputed, since the additional capital can presumably be earning a fair rate of return if invested in the capital markets - see Ryan & Larner, Bride & Lomax, and D'Arcy & Doherty.

Authorised Control Level

The authorised control level RBC is equal to 40% of the total Risk-Based Capital *after* covariance. The total Risk-Based Capital *before* covariance is equal to the sum of the following components of risk:

- asset risk
- credit risk
- off-balance sheet risk
- underwriting loss and LAE (loss adjustment expense) reserve risk
- underwriting premium risk

The total Risk-Based Capital charge *after* covariance is equal to the result of the following formula, which is termed the 'square root rule':

$$R0 = \sqrt{R1^2 + R2^2 + R3^2 + R4^2 + R5^2}$$

where:

- $R0$ = RBC for stocks (common and preferred) for property/casualty US affiliates, non-controlled assets, guarantees for affiliates and contingent liabilities.
- $R1$ = RBC for fixed income investments (including bond size factor adjustment and asset concentration adjustment in respect of fixed income investments)
- $R2$ = RBC for equity investments (including asset concentration adjustment in respect of equity investments)
- $R3$ = RBC for credit risk
- $R4$ = $[RBC \text{ for loss and LAE reserve risk}] \times [0.7 + 0.3 \times LCF]$ plus $[RBC \text{ for reserve growth}]$, where LCF (the loss and LAE reserve concentration factor) is the proportion of the total loss and LAE reserve represented by the largest line of business.
- $R5$ = $[RBC \text{ for written premiums}] \times [0.7 + 0.3 \times PCF]$ plus $[RBC \text{ for premium growth}]$, where PCF (the premium concentration factor) is the proportion of the net written premiums represented by the largest line of business.

Covariance Adjustment

The reason for incorporating a covariance adjustment in the risk-based capital formula is that the total RBC for an insurer should generally be less than the simple sum of the RBC amounts for each risk element, because of the benefits of diversification and because the separate risk elements are not perfectly correlated.

The purpose of the loss and LAE reserve concentration factor and the premium concentration factor is to allow for the effect of diversification between lines of business. Many insurers write several lines of business. It is unlikely that all lines will have adverse results at the same time: for example property catastrophes are probably independent of liability losses and adverse workers compensation reserve development does not always correspond to like movements in automobile liability reserves.

Similarly, many insurers have a broad portfolio of assets including stocks, bonds and real estate. Often the stock and bond markets will move in

opposite directions at the same time, offsetting an adverse impact on one area. Thus an insurer can reduce the chance and magnitude of financial impairment by diversifying its risk across underwriting and asset categories.

The purpose of the square root rule is to allow for the fact that there is a degree of correlation between the different components of risk. The square root rule tends to overstate the true amount of RBC for independent risk elements. However, if risk elements are weakly correlated, which is likely in practice, the square root rule will be a better approximation. (See the "Report on Covariance Method for Property Casualty Risk-Based Capital" in the Summer 1993 edition of the Casualty Actuarial Society Forum).

The covariance adjustment is a very substantial element of the RBC calculation, and this is illustrated by the following breakdown of the total RBC charges for all insurers (excluding professional reinsurers and small insurers) using 1991 data.

	\$ billions	% total RBC
Total surplus	170.2	
Asset risk	28.5	22.6
Credit risk	12.4	9.8
Off-balance sheet risk	1.2	0.9
Underwriting loss and LAE reserve risk	55.0	43.5
Underwriting premium risk	29.3	23.2
<u>RBC before covariance</u>	<u>126.4</u>	<u>100.0</u>
Covariance adjustment	(51.8)	(41.0)
<u>RBC after covariance</u>	<u>74.6</u>	<u>59.0</u>
Authorised control level	29.8	
(40% of RBC after covariance)		

Source: National Association of Insurance Commissioners: Exposure Draft - June 1993

Asset Risk

The asset risk charge is obtained by applying specified percentage factors to the 'statement values' for different categories of assets as follows. The references in brackets show the covariance adjustment factor (if any) to which each risk factor is related.

- **Bonds (R1)**

The RBC charge varies from 0% (Federal Government Bonds) to 30% (bonds in or near default). There is a further charge, termed a bond size factor adjustment, which depends on the number of issuers. The more issuers, the lower is the adjustment. The bond size factor is based on an analysis showing that the default risk for a portfolio of bonds is inversely linked to the number of issuers of the bonds in the portfolio.

- **Preferred Stocks (R0 and R2)**

These are split into non-affiliated (5% charge) and affiliated, which is further split into US Property/Casualty or Life/Health insurers (given a charge equal to their 'excess RBC', i.e. the amount by which their RBC exceeds the common stock statement value), alien insurers (100% charge), investment subsidiaries or non-insurers that control insurers (given a charge equal to their excess RBC) and others (30% charge).

- **Common Stocks (R0 and R2)**

These are split into non-affiliated and affiliated. Non-affiliated is further split into money market funds (0.3% charge) and others (15% charge). Affiliated is further split into US Property/Casualty or Life/Health insurers (given a charge equal to their RBC), alien insurers (100% charge), investment subsidiaries or non-insurers that control insurers (given a charge equal to their RBC) and others (30% charge).

- **Mortgage and Other Collateral Loans (R1)**

5% charge.

- **Real Estate**
10% charge.
- **Cash and Short Term Investments (R1)**
0.3% charge.
- **Other Invested Assets**
20% charge.
- **Aggregate Write In - Invested Assets (i.e. miscellaneous assets)**
5% charge.
- **Asset concentration**
An additional RBC amount which appears to have been set judgementally, is included in order to bring the total RBC factor up to 30% for the ten largest 'single name' exposures (aggregated across all asset types).

The asset risk charge appears to be designed to cover the risk of coupons, dividends, and rents not being paid from the Company's investments, rather than to cover the risk of adverse fluctuations in the market values of such investments. However, the default risk is likely to be correlated to some extent with the market value risk. The asset risk factors were set after consideration of the factors used in the banking and life/health insurance industries.

Credit Risk (R3)

- **Reinsurance ceded**
10% charge, applied to statement value.
- **Miscellaneous Recoverables**
5% charge.
These factors appear to have been set judgementally.

Off-Balance Sheet Risk

Non-controlled assets, guarantees for affiliates and contingent liabilities each have a 1% charge applied to the reported value (R0). The reported value gives little indication of the range of possible values - e.g. certain guarantees could be without limit.

There is also an excessive growth charge equal to the sum of a reserve growth charge (R4) and an premium growth charge (R5).

The **reserve growth charge** is equal to:

$$45\% \times [(a) - 10\%] \times (b) \text{ subject to a minimum of zero,}$$

where:

(a) = three year simple average of the gross written premium annual growth rate, subject to a maximum of 40%, and

(b) = the latest year's net loss and LAE reserves.

The **premium growth charge** is equal to:

$$22.5\% \times [(a) - 10\%] \times (c) \text{ subject to a minimum of zero,}$$

where:

(a) = as above, and

(b) = the latest year's net written premiums.

Loss and LAE Reserve Risk (R4)

The loss and LAE reserve risk factor is computed for each of the following lines of business:

- Homeowners
- Private Passenger Auto Liability
- Commercial Auto Liability
- Workers Compensation
- Commercial Multi-Peril

- Medical Malpractice
- Special Liability
- Other Liability
- 2-Year Line Composite
- Reinsurance A&C
- Reinsurance B
- Reinsurance D
- Products Liability

The first eight and last lines are the old 'schedule P' lines. '2-year line composite' is the total of all short tail lines (development of which was only reported for two years). It is not clear whether there is any degree of choice for insurers in how business is allocated to lines. For example, quota share reinsurance of (say) a homeowners book could potentially be reported under homeowners or under one of the reinsurance categories.

The loss and LAE reserve factor is equal to:

$$(a) \times [(b) \div 1] \times (c) - 1] \text{ subject to a minimum value of zero}$$

where

(a) = loss and LAE reserve, net of reinsurance

(b) = Company RBC% (i.e. 50% weighting to industry RBC%, which vary by line of business, and 50% weighting to industry RBC% multiplied by the ratio of the Company development factor to industry development factor for that line of business),

(c) = adjustment for investment income, based on a fixed 5% rate of return and using payment patterns based on Internal Revenue Service discounting methodology for the non-reinsurance lines and on curve-fitting for the reinsurance lines.

The same formulae apply to both professional reinsurers and other insurers, but with different factors for these two groups reflecting the different nature and categorisations of business.

The industry-average and Company RBC factors for loss and LAE reserves are based on the worst percentage development of calendar year reserves for each of the last ten years, i.e. for the 1992 factors this means the years 1982-91 inclusive.

For example, the loss and LAE reserve risk-based capital component for an insurer writing Homeowners business might be calculated as follows:

1. Loss and LAE reserve = \$10 million (say)
2. Industry-average development = 1.023 (1992 factor)
3. Company development = 1.015 (say)
4. $(3)/(2) = 0.992$
5. Homeowners loss and LAE reserve risk-based capital factor = 0.386 (1992 factor)
6. Company risk-based capital factor = $[(5)/(2)] \times [1 + (4)] = 0.384$
7. Homeowners adjustment for investment income = 0.910 (1992 factor)
8. Loss and LAE reserve risk charge = \$10 million $\times [1.384 \times 0.910 - 1] = \2.59 million

Underwriting Premium Risk (R5)

The underwriting premium risk factor is computed for the same classes of business as the loss and LAE reserve risk factor.

The underwriting premium risk factor is equal to:

$$(d) \times [(c) \times (c) - (f) - 1] \text{ subject to a minimum value of zero}$$

where

(c) = adjustment for investment income, as above.

(d) = net written premium

(e) = Company RBC% (i.e. 50% weighting to industry RBC%, which vary by line of business, and 50% weighting to industry RBC% multiplied by the ratio of the Company average loss and LAE ratio to industry-average loss and LAE ratio for that line of business),

(f) = Company underwriting expense ratio.

Again, the same formulae apply to both professional reinsurers and other insurers, but with different factors between these two groups.

The industry RBC factors for written premiums are based on the highest loss and LAE ratio for the last ten years, i.e. for the 1992 factors this means the years 1982-91.

For example, the underwriting premium risk-based capital component for an insurer writing Workers Compensation business might be calculated as follows:

1. Net written premium = \$20 million (say)
2. Industry-average loss and LAE ratio = 0.902 (1992 factor)
3. Company loss and LAE ratio = 0.95 (say)
4. $(3)/(2) = 1.053$
5. Workers Compensation RBC loss and LAE ratio = 1.009 (1992 factor)
6. Company risk-based capital factor = $[(5)/(2)] \times [1 + (4)] = 1.036$
7. Company underwriting expense ratio = 0.15 (say)
8. Workers Compensation adjustment for investment income = 0.910 (1992 factor)
9. Underwriting premium risk charge = \$20 million $\times [1.036 \times 0.910 + 0.15 - 1] =$
\$1.86 million

Results of Testing

The table below gives the results of tests to determine the proportions of insurers (excluding professional reinsurers and small insurers) based on 1991 data, which would fall into each of the RBC control bands.

Total Surplus as % RBC	Number	Percentage %	Cumulative Percentage %
0-70% (MCL)	27	1.5	1.5
70-100% (ACL)	8	0.4	1.9
100-150% (RAL)	22	1.2	3.1
150-200% (CAL)	21	1.2	4.3
200-250%	38	2.1	6.4
250%+	1,691	93.6	100.0
Totals	1,807	100.0	100.0
No < 100%	35		
No < 200%	78		

Source: National Association of Insurance Commissioners: Exposure Draft - June 1993

Critique of US Risk-Based Capital System

Any risk-based capital system which is being used by regulators to monitor the solvency of insurers needs to reflect a balance between political, theoretical and practical considerations. Such a system needs to be reasonably straightforward to operate in practice.

However, there are a number of criticism that can be made of the US system, which should perhaps be borne in mind when developing a UK formula. These criticisms of the US formula are set out in the following paragraphs.

Several types of risk appear not to have been incorporated into the US formula, including:

- The risk of a substantial adverse movement in the market value of the Company's investments.
- The risk that the nature, currency and term of the Company's assets are inappropriate given the nature, currency and term of the liabilities.
- The risk that the Company is exposed to an accumulation of risk.
- The risk that the Company is exposed to a large catastrophe such as Hurricane Andrew.
- The risk of a significant loss due to exposure to investment derivative instruments.

The calculation of a number of the risk factors appears to be arbitrary. For example:

- The 10% charge against reinsurance ceded in the credit risk factor.
- The allowance for excessive growth in the off-balance sheet risk factor.

Furthermore the treatment of certain items appears rather simplistic.

For example, in theory a higher charge should apply to reinsurance ceded in respect of long-tail than in respect of short-tail business, because there is a higher probability of a reinsurer getting into difficulties before long-tail liabilities become payable than before short tail liabilities become payable.

There is not a consistent conceptual framework for the calculation of risk charges. The loss and LAE reserve risk factor and underwriting premium risk factor are based on worst case industry experience during the last ten years, whereas the stock risk factor is, we understand, based on a statistical measure of variability. (See 'Report on Reserve and Underwriting Risk Factors' in the Summer 1993 edition of the Casualty Actuarial Society Forum.)

The authorised control level risk-based capital is equal to 40% of the total risk-based capital charge after covariance (though this factor may soon be increased to 50%). **It is unclear what this 40% factor represents and it requires more justification.** Inevitably, the precise level of this factor will be dependent to some extent on political considerations. However, it should be possible to justify the factor on the basis of an approximate probability of ruin or expected policyholder deficit.

The method of calculation of the covariance factor adjustment, using the square root rule, is simplistic, particularly when one considers the financial significance of this term. As previously discussed, the square root rule implies a relatively weak level of correlation between the different risk factors (see 'Report on Covariance Method for Property/Casualty Risk-Based Capital' in the Summer 1993 edition of the Casualty Actuarial Society Forum), and it is unclear whether the formula distinguishes in an appropriate way between the different levels of correlation between risk factors which apply to different companies. Furthermore, the formula makes it possible to reduce the required risk-based capital easily by switching a relatively small amount of investments from fixed interest to equities, giving an 'optimal' position that is not intuitively reasonable.

The loss and LAE reserve risk factor and underwriting premium factor are based on the worst case industry experience during the previous ten years. In particular, this means that the current factors reflect the historical experience of the industry in the last underwriting down cycle (i.e. in the period 1982-91), including the severe adverse development that occurred in general liability, medical malpractice and

reinsurance, and the very severe loss ratios in medical malpractice and reinsurance.

The experience during this particular period is dominated by several factors:

- The tort liability explosion, particularly in relation to asbestos and environmental pollution claims.
- High interest rates, creating intense pressures to engage in cash flow underwriting.
- High inflation rates.

While the next down-cycle could easily be as severe, the specific forces that drive it will probably be different. For example there may be a different incidence of natural catastrophes. The distribution of adverse results by line will probably also be different.

The current factors create very high capital requirements (relative to current industry norms) for some lines and very low ones for others. The implications of these factors is likely to lead to significant market dislocation.

Some factors are based on a rolling 10-year history and are therefore 'dynamic', while others are fixed - e.g. the 10% growth benchmark and the 5% interest rate for discounting. **In neither case do these factors seem to reflect appropriately on current values.**

The factors are based on retrospective rather than prospective considerations and are tuned to the features of the chosen period. If the structure of a sector of the market has changed fundamentally, there is no logical reason why the experience of the past 10 years should be representative of future experience.

We have some doubts over the effectiveness of the company-specific adjustments to the loss and LAE reserve risk factor. If a company has taken corrective action and increased its reserves from an inadequate level to an adequate level during the past 10 years, the risk-based capital formula assumes that such reserve strengthening will continue to take

place in the future, although strengthening may not be required. Conversely if a company has weakened its reserves the formula assumes that such weakening will continue to be appropriate to some extent.

The risk charge for Aggregate Write In of Invested Assets of 5% seems very low. We understand this category contains assets that are not otherwise classified, and so we are surprised that such a category has the same risk charge as preferred stocks and mortgages and a lower risk charge than real estate.

The 10% benchmark in the reserve growth charge and premium growth charge is arbitrary and takes no account of real, as opposed to nominal growth (i.e. it ignores inflation). It could be argued that it is only the real growth in exposure which is relevant in this context, and not nominal premium growth.

The adjustment for investment income in the loss and LAE reserve factor does not distinguish effectively between discounted and undiscounted reserves, although this is difficult to achieve since nominally undiscounted reserves may well be understated compared with reserves that are subject to an explicit discount for the time value of money.

The factors use a fixed interest rate of 5%. This may not be appropriate because interest rates have fluctuated substantially during the last 10 years, and the worst case reserve strengthening or loss ratio may correspond to a period when interest rates were significantly different from 5%.

The factors do not distinguish between business written on a claims made basis and business written on an occurrence basis. Factors based on the past experience of business written on occurrence forms are not applicable to business written in the future on a claims made form. This aspect may be improved when definitive instructions are published (probably this Summer).

The actuarial profession only became involved at a relatively late stage in the development of the US formula, although individual actuaries may already have been involved either as consultants or employed directly by regulators. While this absence of involvement is not in itself a criticism, some of the above problems may have been solved by earlier input of the actuarial profession.

Chapter E : Towards a UK Risk-Based Capital Formula

Overview

This chapter comprises the working party's thoughts on how a UK RBC formula might be put together. We did not reach a consensus on the structure of the formula, and we recognise the need for further debate and analysis. Our aim in putting forward the skeleton of ideas below is to encourage comments and suggestions for possible formulae which could then be tested with UK market data.

Conceptual Frameworks

A coherent risk charge structure is assisted by a conceptual framework. One such framework is the notion of probability of ruin, i.e. the aim of a risk charge structure could be to limit the probability of ruin to a specified level over a given time horizon. Alternatively, the aim could be to ensure that a certain set of circumstances (e.g. the last ten years of industry experience) can be withstood. Thirdly, there is the 'expected policyholder deficit' approach, which is based on a theoretical reinsurance premium to cover the tail of the aggregate loss distribution. There is no reason why different conceptual frameworks cannot be used in combination, i.e. to use both probability of ruin and expected policyholder deficit.

What probability of ruin could be regarded as acceptable and over what time horizon? Should the same probability be used for each risk or for the overall company or for the market as a whole? Should there be one rule for professional reinsurers and another for direct companies? Timing must be related to the possibility of obtaining new capital and to the pressures that the supervisor can exert to encourage it. For a company with viable business, the supervisor can exert a lot of pressure, but for a company going into run-off very little unless the supervisor has some leverage against the owners. A one per cent probability of ruin is inadequate as a standard for continuing solvency - there are several hundred authorised

UK insurers - unless there are implicit margins in the provisions which in effect reduce this to a much lower probability.

Another problem with probability of ruin is the famous (hypothetical) example of the insurer providing cover solely for collisions of jumbo jets directly above US baseball stadiums. For this company, one claim will bankrupt the insurer, yet such a claim has a sufficiently remote probability that the company would pass capital adequacy tests based on probability of ruin. This approach does nothing to limit the cost to the market of an insurer insolvency. The jumbo jet example also exposes a problem with expected policyholder deficit.

An insurer who cannot withstand the probable maximum losses (PMLs) for its business (paying due regard to aggregations) should not be writing such business, whatever its probability of ruin or its expected policyholder deficit.

All this points to using a mixture of frameworks, including:

- Probability of ruin
- Expected policyholder deficit
- Capital to meet specific circumstances including PML derived scenarios.

The influence of covariances is clearly a crucial area.

What should be the time horizon for setting risk factors? To recognise that business is conducted dynamically, an infinite horizon is inappropriate. A one year horizon gives too little time for management and regulators to react, and two years seems more appropriate.

The conceptual framework(s) should also consider the commercial effect and the impact on the industry and by extension the economy as a whole, as well as the effect on the policyholders.

Criteria for Requiring a Risk Charge

A risk charge should be associated with any feature, uncertainty in which may give rise to a diminution in net assets. This approach would give rise

large in respect of, for example, employee costs, perhaps as part of global expense related item. The size of the loss which may be associated with the feature should ideally be capable of quantification, perhaps only in combination with that due to other features. If not quantifiable, but nevertheless important, some ad hoc measure could be justifiable. The loss which may be associated with the feature should be significant, perhaps only in combination with other features.

List of Risk Factors

To summarise Chapter C, an insurer is subject to the following risks:

- Uncertainty of Claim Costs
- Trends and Cycles in Claims and Premium Rates
- Inflation and Currency Movements
- Asset Risk
- Run-off Risk
- Catastrophe Risk
- Credit Risk

Each of these applies across the different classes of the insurer's liabilities and assets, but are mitigated by

- Reinsurance
- Asset/Liability Matching

Response to Risk Factors

Allowance should be made in the RBC charge for the time value of money. It should also be made for discounting, so that companies which discount or do not discount are treated consistently.

Equity-type investments should be treated differently from fixed income investments, and there should be an allowance for the risks of mismatching by nature, currency and term.

RBC should recognise that the exposure to credit risk depends not only on the year end balance but also on the annual throughput. It should allow

for the number and size of brokers and agents, and recognise that the outstanding balance could deteriorate.

RBC should recognise that the DTI's role in Lloyd's is different, effectively looking at the adequacy of the guarantee fund (i.e. Lloyd's Central Fund).

In assessing the RBC charge for reinsurance recoveries, the differences between possible reinsurance programme structures (e.g. quota shares vs. excess of loss) should be recognised. RBC should recognise differences between credit ratings of reinsurers and timing of recoveries, as well as letter of credit or trust fund collateralisation. It should also allow for variations in the estimates of amounts recoverable and for amounts already written off as bad debts.

Ideally the reinsurance RBC charge should be split into a two-way classification by reinsurer and timing, but it should be understood that it may be difficult for companies to produce this information. Therefore either a transition period should be allowed or there should be an alternative, more penal, charge for companies that cannot provide this breakdown.

The RBC charge should include an element for one or more catastrophe scenarios. Such a scenario may be uncorrelated with the company's other risks, so a covariance adjustment should be made.

With some of the conceptual frameworks considered, the capital required to meet the specified criteria is non-linear in respect of premiums, reserves, or asset values for the stochastic element of risk. However, the existence of other risks may swamp the theoretical position for that part of the risk that can readily be subjected to statistical analysis. A larger insurer will write not only more (independent) risks but also some larger risks (which a smaller insurer cannot). A linear response to the various measures may well be more appropriate than, say, a logarithmic response.

The US factors seems to be based on linearity. The response curve should be tested theoretically by simulation using different aggregate loss

distributions, since a formula that is valid for both small and large insurers is needed. Testing of the response curve for sensitivity to variations in frequency and severity should also take place, since size can be increased either by writing larger lines or by increasing the number of risks written. It will also be necessary to model the impact of uncertainty in the reserve estimates.

Combining the Risk Factors

These risks may not all be independent and so a covariance adjustment may not be appropriate in all cases.

Run-off risk is clearly not independent of the others: run-off may often occur because of some or all of the other factors going bad. On the other hand management and/or shareholders can decide to put a company into run-off at any time. To take into account the further problems that run-off will cause, the RBC emerging from the other factors should be increased.

Some of the risk factors can be seen as two sides of the same coin, or at least operating in a similar fashion to each other. For example, investment returns and inflation mitigate one another: it is the net effect which is of concern. In this particular case, the two are known not to be independent - high inflation is often accompanied by increasing net asset values - and it is suggested that a single factor be used, combining the two effects.

The differences between the major lines of business should be recognised, as should the practical difficulties in producing data that is not currently part of the DTI returns. A compromise solution is to use DTI accounting classes information, which gives a reasonable number. Gross of reinsurance exposures should be taken into account, but RBC should also reflect the fact that reinsurance recoveries will be strongly correlated with gross losses.

Allowance should be made for the correlation between reserves and premium adequacy within the same class of business and for the correlation between adequacy (of reserves and premiums) across classes. RBC should recognise that the reliability of reserves is likely to be

improved if a loss reserve specialist has provided a favourable opinion on them. However, this does not necessarily mean that the reserves will be able to cover specific adverse scenarios in these circumstances.

Classification of Business

General insurance business is classified in a number of ways for the purposes of financial reporting, management information, and actuarial analysis. These classification systems are usually related, to one degree or another, to the underlying risk characteristics of the business.

For supervisory purposes, business is reported by DTI accounting class of business and within that by risk group or (for Lloyd's) by 'audit code'. The DTI risk groups are subjective classifications performed by the company's management, but with a degree of common ground between companies. They must consist of risks that are similar in the opinion of the company's directors. The DTI's long-term objective is to level up the degree of companies' sophistication. For the purposes of Risk-Based Capital, the DTI classification scheme (at the accounting class level, but with reinsurance business segregated into property and casualty) should be sufficient in the early stages.

Past Written Business

For most insurance companies a significant level of uncertainty is associated with the liabilities of past business written. This uncertainty can be divided into:

- liabilities for claims that have been incurred whether or not they have been reported;
- liabilities for claims that have not yet been incurred.

The second category reflects the risk that premiums not yet earned, together with unexpired risk provision if any, on existing policies, will be insufficient to cover future claims incurred during the policy period. This is addressed as an adjunct to the next section, Future Written Business.

In regard to claims that have been incurred, the following elements need to be considered:

- reported claims and adequacy of the reserves related thereto
- IBNR claims
- timing of payments
- future claims handling expenses
- security of reinsurance.

These elements are affected by changing economic, judicial and social environments.

Future Business

The discussion above describes the uncertainty associated with claims that have been incurred, but not yet settled. For business written in the future, the level of uncertainty is usually higher, because instead of merely understanding the past, the actuary/underwriter must forecast the future. (Otherwise the discussion will be similar to the previous discussion).

In addition to forecasting future claims experience, there are a number of other variables that introduce additional uncertainty, such as expenses, premium volume, premium rates, competitive pressures, and regulatory changes. Also changes in legislative and judicial environment may affect past written business as well as the future business.

As noted previously, the consideration of business that has already been written but has not yet been earned is similar to the future written business, the major difference being that the premiums are already known (usually).

The insurance cycle means that there may need to be an unexpired risk provision, but it is hard to measure where you are in the cycle. Measurement directly of exposures may help. For Lloyd's the idea is that committees would decide whether rates were hard or soft in particular years. It is unrealistic to expect the DTI to similarly monitor prospective rate adequacy even for UK business alone.

Ideally the suitability of the reinsurance programme should be considered but is difficult to take into account. Will reinsurance be available (e.g. terrorism cover)? If so at what price? If it is not should the company

continue to write classes of business that are reliant on reinsurance support?

For future business, the question of the time horizon is raised. One important factor is how long it would take the regulator, or even the company's own management, (a) to realise it had problems and (b) to act on that knowledge. This depends on the tail of the business. It also depends on how much experience the company has of that business. A growth charge at a class level may be appropriate in these circumstances. Can this be anticipated?

Equalisation reserves cut across both past and future business, and in this sense they are like certain types of financial reinsurance (with no transfer of risk).

Assets

The following asset classes exhibit different risk characteristics, and therefore a separate risk charge should be computed for each.

- **Property**

This might be split between domestic and overseas property holdings with a special grouping for those properties from which the insurance company conducts business. The illiquidity of property assets is particularly relevant and justifies separate treatment, although property behaves to some extent like fixed interest and/or equities.

- **Equities**

These may be split into many categories, perhaps the most important being between quoted and unquoted. It may also be worth splitting equity holdings by economic area (e.g. UK vs. overseas) and by market sector (especially between the insurance sector and others).

- **Fixed Interest**

These should be broken down into bonds of different security ratings ranging from government backed to corporate bonds that are in default.

They could also be split by maturity. Also there should be a split between currencies and index-linked bonds should be treated separately.

- **Miscellaneous**

One important class that needs to be considered is derivatives. The RBC should look at whether the derivative is held for hedging or speculation (or indeed whether the company is itself writing derivative contracts). The counterparty risk needs to be considered.

Diversification should be allowed for in the RBC charge. The asset admissibility rules are a step in this direction. However, it may not be necessary to have them with a suitably formulated RBC. Holdings of equities or bonds in any company within the same group need special treatment, and non-insurance holdings need to be distinguished from insurance holdings.

Outline Proposals for a UK Formula

The basic RBC required should be computed according to a formula incorporating the following:

- Future business RBC
- Past business RBC
- Reinsurance RBC
- Catastrophe RBC
- Credit RBC
- Asset RBC

Future and past business RBC would be computed from factors applied to premiums (after making some allowance for growth) and reserves. Different factors for different classes of business would be used and there would be different factors for different elements of the reserve (e.g. the IBNR factor would be higher than the factor applied to known outstanding claims). A favourable actuarial opinion on the reserves could be used to allow lower past business factors. It is debatable whether the risks of under-reserving or under-pricing in different lines of business offset one another, so a simple sum of RBCs is proposed.

Different companies reserves would need to be put on the same footing, so discounted reserves would need to be converted back to undiscounted reserves (or vice versa) and any claims equalisation reserves stripped out before applying common RBC factors to the reserves.

Reinsurance would be allowed for by basing future and past business RBC on net of reinsurance premiums and reserves, but it may be appropriate to restrict the proportion of reinsurance that is allowable (at least for certain types of reinsurance) for the purpose of RBC. All this assumes that the reinsurance programme is appropriate.

Reinsurer failures would be allowed for separately in an RBC charge based on reinsurance premiums or reserves. This would ideally require reinsurers categorised according to expected timing of receipt of recoveries and recoverability ratio. This may be difficult to achieve in the early days owing to lack of data from some insurers. It may be appropriate to apply an overall factor to companies that can obtain the necessary information and different (more penal) factors to those that cannot. In assessing the recoverability factors, any letters of credit or trust funds could be taken into account. The reinsurance RBC would be simply added to the previous RBC elements, as there is likely to be strong correlation between reinsurer failures and under-reserving or under-pricing.

Catastrophe RBC would be calculated by using PMLs (after reinsurance) for a range of specified events. For these the square root rule can be used to adjust for correlations with the earlier factors, except possibly reinsurance.

Non-reinsurance credit risk is also highly correlated with insurance industry fortunes, and therefore this would be a simple addition to the earlier RBC elements.

The asset RBC needs to reflect income and capital risk and these can initially be treated as an addition to the other RBC elements. Diversification of the investment portfolio should give rise to a RBC credit in some way. Provided the assets and liabilities are well matched, backed

up by a suitable opinion from auditors or an actuary, the square root rule can be used to reduce the RBC required.

Final Thoughts

Much further work needs to be done to establish a workable formula. In this paper we have sought to identify issues but our discussions have brought out how difficult such a task is likely to be. Any formula requires very careful testing before being put forward for possible legislation, and this testing should include considering the impact on not only the large UK composite insurers but also smaller specialised companies, and those operating in direct competition with overseas insurers.

In proposing a recognition of the benefit from independent opinions (e.g. from actuaries) on reserve adequacy and the degree of asset/liability matching, we accept that suitable professional guidance would need to be established. There may be a case for the value of the actuarial opinion to be dependent on the time period over which the company has used actuaries. This would recognise the improvement in data (as well as methodology) that would be expected from long term actuarial involvement in a company.

Appendix 1 : Standard Risk Group Descriptions

These are the Standard Risk Group codes compiled by the DTI. They are based on what companies are actually doing, and are not intended to represent best practice as regards classification. There is a considerable overlap between different risk groups. The Canada and USA risk groups (which appear in Accounting Classes 6, 7, 8) merit further explanation. This relates to Home Foreign business where the risk is located in Canada or the USA. Since 1981 Home Foreign has been, for DTI return purposes, a separate 'country' where business may be carried on.

ACCOUNTING CLASS 1 - ACCIDENT AND HEALTH

Personal Accident
Group Personal Accident
Aviation Personal Accident
Personal Accident Travel
Accident Monthly
UK School Fees Scheme
Weekly Business
Commercial
Special Risks
Fireman's Loss of Licence
Credit Accident and Health
Health Care
Group Medical Aid
Individual Purchase
Other*

* To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 2 - MOTOR VEHICLE, DAMAGE & LIABILITY

Private Car Comprehensive
Private Car Fleet Comprehensive
Private Car Non-Comprehensive
Private Car Fleet Non-Comprehensive
Commercial Vehicle
Commercial Vehicle Comprehensive
Commercial Vehicle Non-Comprehensive
Motor Vehicle Liability
Private Car Liability
Commercial Car Liability
Commercial Vehicle Liability
Accidental Damage
Private Car Accidental Damage
Commercial Car Accidental Damage
Commercial Vehicle Accidental Damage
Motor Bicycle - Comprehensive
Motor Bicycle - Non-Comprehensive
Motor Bicycle
Private Hire
Self Drive Hire Commercial Vehicle
Motor Trade
Black Cabs
Public Service Vehicles
Collision Damage Warranty
Supplementary Cover (Other than Liability)
Caravans
Motor Fleet
Motor Excess Layers
Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 3 - AIRCRAFT, DAMAGE & LIABILITY

Home Aviation
Home Foreign Aviation
Hull
Airline Hull
General Aviation Hull
Airline
General Aviation
Satellites
Satellites Launch
Satellites in Orbit
Liability
Airline Liability
Aviation Passenger Liability
Aviation Products Liability
General Aviation Liability
Other Aviation Liability
Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 4 - SHIPS, DAMAGE & LIABILITY

Home Ships and Liability
Home Foreign Ships and Liability
Excess of Loss
Marine Hull
Home Marine Hull
Home Foreign Marine Hull
Canadian Marine Hull
United States Marine Hull
Other Hull
Small Craft
Liability
Charterers Liability
Protection and Indemnity

Rig
Building
Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 5 - GOODS IN TRANSIT

Home Goods in Transit
Home Foreign Goods in Transit
Difference in Conditions
Cargo
Marine Cargo
Aviation Cargo
Marine Cargo/Air Cargo
Transport Luggage
Inland Transport
Inland Marine
Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 6 - PROPERTY DAMAGE

Canadian
United States of America
Special Risks
Difference in Conditions
Property Liability
All Risks
Miscellaneous All Risks
Industrial All Risks
Commercial All Risks
All Risks Excluding Industrial All Risks
Commercial/Industrial All Risks
Deterioration of Stock
Fire, Theft and Allied Perils

General Accident
Personal
Other Industrial
Seepage and Pollution
Commercial Comprehensive
Non-Manufacturing and Simple Risks
Hotel
Office
Retail
Manufacturers
Heavy Engineering, Manufacturing and Electrical Risks
Light Manufacturing
Industrial and Commercial Property
Domestic Comprehensive
Marine Department Property
Drilling Platform
Oil and Chemical and Gas
Pipelines
Nuclear Pools
Railway Rolling Stock
Contractors All Risks
Contractors All Risks/Engineering
Engineering
Computer All Risks
Machinery Breakdown
Extended Warranty
TV Sets, Video and Satellite
Theft and Damage
Domestic/Commercial and Industrial
Burglary
Burglary Trade
Private Burglary
Theft
Bloodstock
Livestock
Bloodstock/Livestock
Agriculture

Hail/Agricultural Risks

Hail

Caravan

Money

Contact Lens

Spectacles

All Risks Photographic

Cycle

Plate Glass

Goods In Transit

Travel

Perils

Catastrophe

Earthquake

Water Damage

Sprinkler Leakage

Riots

Terrorism

Fire

Fires In Transit

Fire Excess of Loss

Commercial Fire

Fire - Domestic

Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 7 - GENERAL LIABILITY

Canadian

United States of America

Special Risks

Contingent Liability

Excess Liability

Public Liability

Commercial

Contractors General Liability

Products Liability
Property Damage
Professional Indemnity
Medical Malpractice
Directors'/Officers' Liability
Employers Liability
Workers' Compensation
Noise-Induced Hearing Loss
Industrial Disease
Other*

*To be used only where a more precise classification is not practicable.

ACCOUNTING CLASS 8 - PECUNIARY LOSS

Canadian
United States of America
Special Risks
Difference in Conditions
Contingency
Political Risk
Loss of Licence
Surety and Credit
Surety
Fidelity
Bankers Blanket
Deposit Guarantee Scheme
Film Completion Guarantees
Assignors Leaseholders Liability
Motor Vehicle Title
Credit
Redundancy and Unemployment
Personal Loans
Mortgage Guarantee
Hospital Insurance Plan
Accident
Credit Card Loss

Consequential Loss
Book Debt
Commercial and Industrial Consequential Loss
Industrial All Risks
Commercial
Hotel
Office
Retail
Marine Pecuniary Loss
Cash In Transit
Advance Profits (CAR and EAR)
Engineering Loss of Profits
Extended Warranty
Mechanical Breakdown
Domestic Equipment
Television Sets, Videos, Satellite
Television Sets
Videos
Satellite
Motor Warranty
Theft
Travel
Livestock
Legal Expenses
Assistance
Fire and Allied Perils
Architects Fees
Other*

*To be used only where a more precise classification is not practicable.

Appendix 2 : List of References

ACTUARIAL. ADVISORY COMMITTEE, TO THE NAIC PROPERTY & CASUALTY RISK-BASED CAPITAL WORKING GROUP, Property-Casualty Risk-Based Capital Requirements - A Conceptual Framework, Casualty Actuarial Society Forum, Spring 1992.

ACTUARIAL. ADVISORY COMMITTEE TO THE NAIC PROPERTY/CASUALTY RISK-BASED CAPITAL WORKING GROUP. Report on Covariance Method for Property/Casualty Risk-Based Capital. Casualty Actuarial Society Forum, Summer 1993.

AMERICAN ACADEMY OF ACTUARIES PROPERTY/CASUALTY RISK-BASED CAPITAL TASK FORCE, Report on Reserve and Underwriting Risk Factors, Casualty Actuarial Society Forum, Summer 1993

BRIDE, M. AND LOMAX, M.W., Valuation and Corporate Management in a Non-Life Insurance Company. Paper Discussed at the Institute of Actuaries 28 February 1994

D'ARCY, S.P. AND DO'ERTY, N.A., The Financial Theory of Pricing Property-Liability Insurance Contracts, Wharton School Monograph. University of Pennsylvania, 1988.

GENERAL INSURANCE STUDY GROUP WORKING PARTY, Report on Risk-Based Capital, General Insurance Convention, Hinckley Island. October 1993

INSTITUTE OF ACTUARIES, Guidance Note GN12 : General Insurance Business Actuarial Reports, July 1991

PENTIKAINEN, T. (ED), Solvency of Insurers and Equalisation Reserves, Insurance Publishing Company, Helsinki, 1982

REDMAN, T.M. & SCUDELLARI, C.E , A New Look at Evaluating the Financial Conditions of Property and Casualty Insurance and reinsurance Companies, Insurer Financial Solvency, Volume 2, 1992 Discussion Paper Program, Casualty Actuarial Society, 10-13 May 1992

RYAN, J.P. AND LAKNER, K.P.W., The Valuation of General Insurance Companies, Journal of the Institute of Actuaries, Vol 117 Part III, 1990.