

**European Commission**

Study into the methodologies to assess  
the overall financial position of an  
insurance undertaking from the  
perspective of prudential supervision

Appendices

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## Comparison of IAIS<sup>1</sup> core principles with EU Directive requirements

The IAIS core principles can be mapped against the requirements of the EU Directives as follows:

	IAIS Principle <sup>2</sup>	EU Directive
Assets	<p>Standards should apply at least to an amount of assets equal to the technical provisions and should address:</p> <ul style="list-style-type: none"> <li>■ Diversification by type;</li> <li>■ Any limits, or restrictions, on the amount that may be held in financial instruments, property and receivables;</li> <li>■ The basis for valuing assets which are included in the financial reports;</li> <li>■ The safekeeping of assets;</li> <li>■ Appropriate matching of assets and liabilities;</li> <li>■ Liquidity.</li> </ul>	<p>It has been left for individual Member States to determine the nature of assets permitted to cover technical provisions and the rules for valuing such assets. No rules are permitted limiting the choice of assets in excess of those representing the technical reserves.</p> <p>There is a requirement that technical reserves are covered by equivalent and matching assets localized in each country where activities are carried on.</p>

<sup>1</sup> International Association of Insurance Supervisors

<sup>2</sup> Extracted from IAIS Insurance Core Principles

<p>Liabilities</p>	<p>In developing standards, the insurance supervisor should consider:</p> <ul style="list-style-type: none"> <li>■ What is to be included as a liability of the company, for example, claims incurred but not paid, claims incurred but not reported, amounts owed to others, amounts owed that are in dispute, premiums received in advance, as well as the provision for policy liabilities or technical provisions that may be set by an actuary;</li> <li>■ The standards for establishing policy liabilities or technical provisions;</li> <li>■ The amount of credit allowed to reduce liabilities for amounts recoverable under reinsurance arrangements with a given reinsurer, making provision for the ultimate collectability.</li> </ul>	<p>The Directives require companies to hold sufficient technical reserves, but the amount of the technical reserves are to be determined according to the rules fixed by the Member State.</p> <p>Where Member States allow technical reserves to be covered by claims against re-insurers, they are to fix the percentage so allowed, but the level of fix is left to the Member States to determine.</p>
<p>Capital Adequacy and Solvency</p>	<p>Requirements regarding the capital to be maintained by companies should be clearly defined and should address the minimum levels of capital or the level of deposits that should be maintained. Capital adequacy requirements should reflect the size, complexity and business risks of the company in the jurisdiction</p>	<p>The Directives require a solvency margin calculation to be performed and provide a list of assets that may cover this amount. They also set out a calculation of the minimum solvency required.</p>

<p>Derivatives and 'off-balance sheet' items</p>	<p>The insurance supervisor should be able to set requirements with respect to the use of financial instruments that may not form a part of the financial report of a company. In setting these requirements, the supervisor should address:</p> <ul style="list-style-type: none"> <li>■ Restrictions in the use of derivatives and other off-balance sheet items;</li> <li>■ Disclosure requirements for derivatives and other off-balance sheet items;</li> <li>■ The establishment of adequate internal controls and monitoring of derivative positions.</li> </ul>	<p>The Third Directive requires that derivatives are only used in so far as they contribute to a reduction of investment risks or facilitate efficient portfolio management. They must be valued on a prudent basis and may be taken into account in the valuation of the underlying assets.</p> <p>They refer to requiring companies to have adequate internal control mechanisms without providing any additional guidance on the areas to be covered.</p>
<p>Reinsurance</p>	<p>The insurance supervisor must be able to review reinsurance arrangements and to determine the appropriateness of such reliance. Insurance companies would be expected to assess the financial position of their reinsurers in determining an appropriate level of exposure to them.</p> <p>The insurance supervisor should set requirements with respect to reinsurance contracts or reinsurance companies addressing:</p> <ul style="list-style-type: none"> <li>■ The amount of the credit taken for reinsurance ceded;</li> <li>■ The amount of reliance placed on the insurance supervisor of the reinsurance business of a company which is incorporated in another jurisdiction.</li> </ul>	<p>Limits are required to be set on the credit to be given for reinsurance (see liabilities above).</p>

## Description of risks facing insurance companies

### *Risks at company level (entity level)*

#### *Underwriting risk*

Underwriting risk can be divided between pure underwriting risk which is the risk related to the random fluctuation of losses or experience and underwriting management risk which is the risk associated with the company's own underwriting procedures.

#### *Underwriting risk - Pure underwriting risk*

The fundamental risk associated with insurance business is that the actual cost of claims arising from contracts will differ from the amounts expected to arise when the contracts were priced and entered into. The key risk is that the insurer has either received too little premium for the risks it has agreed to underwrite and hence has not enough funds to invest and pay claims, or that claims are in excess of those projected<sup>3</sup>. This could occur for the following reasons:

- Risk of mis-estimation: the expectations regarding losses are based on an inadequate knowledge of the loss distribution, or the underlying assumptions are erroneous. This can be due, for example, to sampling errors, or lack of experience with new insurance risks. This risk can be mitigated, to some extent, by diversification of risks.
- Risk of random deviation: expected losses deviate adversely due to a random increase in the frequency and/or severity of claims or because losses fluctuate around their mean. Reasons for this kind of deviation are, for example, that one event triggers multiple losses (accumulation, for example, in the case of natural catastrophes); or a loss experience triggers other events (for example, contagious diseases in health insurance or a fire which affects neighbouring industrial properties leading to business interruption claims, or group life assurance). The significance of this type of risk in a portfolio depends on various factors, such as the number of risks involved, the distribution of probabilities of incurrance of claims and probable maximum losses. This risk is systematically decreased by the pooling approach, that is, assembling as many homogenous and independent risks as possible in the portfolio (pool).
- Risk of change: adverse deviation of expected losses due to the unpredictable changes in risk factors that have brought about an increase in the frequency and/or severity of losses or payment patterns (for example, changing legislation, changing technology, changing social, demographic or medical factors, changes in climate and weather patterns). Again, diversification of the reinsurer's portfolio of business may contribute to the mitigation of this type of risk.
- Reserving (provisioning) risk: In addition to the insured risk itself, there is a derived risk caused by the reserving process of the insurer. This is the risk that technical provisions are insufficient to meet the liabilities of the reinsurance undertaking (reserve risk). If sufficient data on historical claims development is available, this risk may, to a limited extent, be mitigated by proper actuarial estimation of the provisions for claims incurred

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<sup>3</sup> Babbel, D. / Santomero, A.: Risk Management by Insurers: An Analysis of the Process, in: Wharton Financial Institutions Center Research Papers, No. 96-16, 1996.

but not reported (IBNR) and those incurred but not enough reported (IBNER). The risk can rarely be completely extinguished, even where sophisticated actuarial estimation methods are used, due to the inherent uncertainties of insurance (and reinsurance) business.

### *Underwriting risk - Underwriting management risk*

The exposure to the deviation risk related to pure underwriting risk depends on the company's underwriting procedures to control the quality of risks written, prudent evaluation of premiums, exposures and capacity to underwrite risks.

Poor underwriting decisions have a direct impact on the company's profitability through inadequate premium levels to cover the level of risks accepted, higher than anticipated claims expenses and the necessity to liquidate assets earlier than expected in order to fund claims payments.

Diversification of risks as well as avoiding excessive accumulation and concentration of losses have to be carefully assessed by underwriting managers. Underwriting managers should have the appropriate training and experience to evaluate exposures. They should also fully understand the extent and appropriateness of their reinsurance program and ensure that it corresponds with the nature and objectives of their business.

### *Credit risk*

Credit risk is the risk associated with the non-recovery of receivables due to the insurer from third parties. This could be due to debtors defaulting on premiums due, either directly or from brokers. The failure of major reinsurers would cause serious financial difficulties due to the inability of the reinsurers to meet their financial obligations, this is the major area of credit risk for non-life insurers.

Another area of credit risk is on the investment side where losses could be incurred if a counterparty defaults. In addition, if counterparty credit rating is decreased this will cause a reduction in the value of an investment.

### *Reinsurance*

The extent and quality of reinsurance purchased will establish the level of protection available to an insurer. The purchase of insufficient cover can lead to financial difficulties in the event of major unexpected claims. Accordingly, the risk of an inadequate reinsurance programme should be recognised as a key risk.

Reinsurance protection is of less significance to a life insurance company where there is less reliance on reinsurance.

### *Operational risk*

Operational risk is the risk related to internal failures including management incompetence, misselling, fraud, criminal intentions, and error in systems and processes. Underwriting management is only a specific part of the operational risk. Operational risk is interrelated to all other risk factors within an insurance company.

### *Investment (or market) risk*

At company level, investment risk is directly associated with investment management. Investments are purchased by insurers to fund claims expected to be paid in the future. Hence, it is vital to have controls and manage the risks in the portfolio to reduce the risk of poor performance and returns. There are, of course, external factors such as market value fluctuation which will determine the performance of investments (this is discussed under systemic risks below). Investment risk is likely to be less significant for life companies than non-life companies as for investment type products a significant element of investment return accrues to policyholders. Shareholders however often do bear a significant amount of the risk for certain types of product. There is also credit risk associated with investments which is discussed under credit risk above

### *Liquidity risk*

Liquidity risk is the risk of the insurer not being able to liquidate its assets to meet financial obligations. This risk is due to the marketability of certain assets, delays in the selling process and having to accept lower prices. Liquidity risk is interrelated with investment risk.

### *Matching risk*

Matching risk is the risk that liabilities and assets are not appropriately matched. This risk is mainly driven by currency mismatch, timing mismatch, interest rate risk and inflation risk, and is of major importance in life insurance. If a company is not appropriately matched then this could lead to investment losses being suffered as a result of the necessity to liquidate assets to meet claims payments as they fall due. An example for life insurance is that it is necessary to match annuity liabilities with investments with a similar payment pattern, for example fixed income securities.

### *Expenses risk*

Expenses risk is a particular risk for life companies where they have high fixed costs which need to be recovered by expense loadings in premiums charged. The recovery of these costs is therefore dependent on the level of business sold by the life company. In life insurance ,operating and administrative expenses may also increase due to extension of the duration of the contracts beyond the expected duration taken into account when the premiums were calculated. In non-life insurance the major risk driver is the significant cost of legal expenses for claims that have to be settled in court such as employers liability and motor insurance.

### *Lapses risk*

Where a policyholder cancels (or surrenders) their policy before maturity this will result in a lower level of recovery of fixed costs. This is less of an issue for non-life insurance due to the shorter duration of the contract. Where upfront commission is paid then it may be difficult to recover with respect to lapses.

### *Provisioning risk*

Where provisions are set at a lower level than actually required then this could present the company's financial position in a better light than it actually is. This could result in inappropriate underwriting decisions being made. For example, more risky policies may be underwritten on the basis that more capital is available to support this than is actually the

case, or higher levels of business may be written. Other inappropriate management decisions may also be made.

### *Other financial risks*

Other financial risks are other risks which could give rise to financial loss for the insurance company. For example providing guarantees in favour of third parties, contingent liabilities, off-balance sheet financing, risks associated with investments in subsidiaries and associates and risks associated with changes in taxation legislation (fiscal risk).

### *Systematic risks (insurance industry specific)*

Systematic risks are the risks driven by external factors that affect the whole insurance industry. In most cases the insurance company is unable to control these risks.

### *Jurisdictional and legal risk*

Jurisdictional and legal risk is the risk associated with the financial impact of changes in regulation and law. Insurers need to understand the implications of changes in legal and regulatory requirements and implement internal systems to meet the requirements from supervisory authorities. For example, court decisions in the US have had a significant impact on non-life liability claims, in relation to asbestosis and pollution. In life assurance it is possible for policyholders to contest bonus allocation rates determined by companies in the courts which could have significant implications for liabilities to policyholders.

Companies in general need to consider the adequacy of their own provisions in the light of court rulings with respect to specific companies. The recent Equitable Life case in the UK in connection with guaranteed annuity rates is an example of how a court decision can have significant adverse implications for a particular company and also caused the rest of the industry to review the level of their own liabilities with respect to similar policies.

### *Market changes risk*

Insurance companies are affected by consumers' attitude and actions by competitors. Consumers' needs and attitude towards buying insurance are the main drivers of insurance sales and therefore premium income and there is likely to be significant competition between companies in relation to premiums and products. Marketing strategies, competitive premiums and products, adaptability to market changes and effective use of different distribution channels will help the insurer to reduce the risk of financial downside from market changes.

In the non-life insurance market one of the major market drivers is the insurance cycle. For example, when there are new competitors entering the market this often leads to premiums being depressed and overcapacity in the market. There is a higher risk at this time of insurers entering into uncompetitive contracts.

### *Systemic risks (local / global economy)*

Systemic risks are related to local or global economic or social factors that will indirectly have an impact on the insurance industry. In most cases the insurance company is unable to control these risks.

### *Market value fluctuation of investments*

This is the risk related to variability in the market value of assets, particularly depreciation of assets due to economic conditions. Depending on the nature of investments, the fluctuation of assets value will have higher or lower impact for the insurer. It is therefore necessary that this risk is controlled by the investment manager as discussed above with respect to company specific investment risk. It is also important to note that in life insurance a proportion of the investment risk is borne by the policyholder.

### *Environmental changes risk*

Environmental changes risk is the risk of a significant increase in the frequency of natural perils and environmental changes. Underwriting managers must aim to reduce susceptibility to major losses due to natural perils by limiting the total exposure in certain territories. A recent example of environmental changes is the recent climatic phenomenon El Niño which caused a considerable increase in frequency of natural perils and therefore insured losses. In life insurance death and health related claims as a result of natural perils increase mortality and morbidity experience.

### *Social changes risk*

Demographic changes and consumer behaviour are the main drivers of social risk. Demographic changes, such as increased longevity, have high financial impact in life insurance since the duration of some policies (eg annuities) depends on the longevity of the policyholder. Increased longevity has negative implications for the cost of annuities but positive implications for term life assurance. Social changes will also affect the insurance industry. For example in the UK, the insurance industry has experienced an increase in frequency and amounts of claims related to compensation for accidents and injuries due to increases in the propensity to claim. Other social changes, such as increased criminality, will also indirectly affect the number of insured losses due to crime and theft. For life insurance, the rapid development of AIDS has caused a significant increase in term assurance premiums in some countries.

### *Economic cycle risk*

Economic cycle risk is the risk related to economic changes due to external processes and factors. For example, in times of recession the insurance industry might be exposed to a reduction of insurance sales and hence a reduction of premium volume. Other secondary factors related to economic changes will also have an indirect impact on the insurance industry, for example, an increase in unemployment might result in an increase in mortgage indemnity claims and in life assurance gives rise to an increase in the risk of contract termination, surrenders and lapses due to inability to pay the corresponding premiums or the policyholder's need to realise their investment. Unemployment might also increase criminality, therefore claims related to crime and theft in non-life insurance will also increase.

### *Inflation rate risk*

Inflation rate risk is the risk related to significant increase in inflation rate. For non-life insurance the effect of higher inflation rates is significant in the calculation of provisions for long-tail business, i.e. for those lines of business in which claims might be settled a long time after the reporting date. For life insurance, inflation plays an important role for long term contracts if payments are subject to adjustments for inflation or loadings for expenses are fixed in nominal terms. Inflation is of particular importance for health and medical insurance since in these cases claims inflation is likely to be higher than economic inflation.

### *Interest rate risk*

Interest rate risk is the risk directly associated with sudden changes in interest rates. For example if interest rates rise then this might cause lower return of investments (other than cash) (as investors move from shares to cash) and depreciation of investment values. In life insurance, sudden decreases in interest rates will impact adversely on the provisions made for policies in force, since for many products the provisions are calculated by discounting the future payments. There may be a risk to solvency if matching assets are not held. In life insurance increases in interest rates may lead to lapses or surrenders as policyholders may no longer be able to afford the premiums or may need to realise their investment.

### *Exchange rate risk*

With exchange rate risk changes in exchange rates will have high impact for insurers underwriting large volume of business in overseas countries, or for global insurers. This risk might be reduced by investing in assets in the same currency in which the liabilities will occur. In life insurance for investment business a proportion of this risk may be borne by the policyholder.

### *Technological changes risk*

This risk relates to the rapid development of new technologies. Technological changes have an impact in different areas of insurance business. For example, technological changes may have a significant impact on people's health (for example Repetitive Strain Injury) resulting in an increase in health insurance and employer's liability claims. Technological changes are also likely to result in an increase in pollution which could increase the level and frequency of liability claims.

Technological changes also have a direct impact in the effectiveness of distribution channels and therefore on premium income. A recent example is the use of the internet to sell insurance, this reduces administrative costs for the insurer and thereby enables insurers to price their products more competitively. This could have an adverse impact on insurers using more traditional distribution channels however not all consumers might have access to the internet or want to purchase insurance in this way. Such customers are more likely to value the advice and personal contact of traditional distribution channels.

Technological developments will also impact traditional lines of insurance such as marine, aviation and motor insurance due to modernisation of material and techniques used in the development of ships, aeroplanes and cars. Rapid development and evolution of information technology systems could have a significant impact on insurers' losses, (for example major losses that would have occurred for the insurance industry if the year 2000 failures had materialised).

## Probabilistic DFA

### *Components of a probabilistic DFA*

A simplified overview of a description of a probabilistic DFA is included in Chapter 3. The main components included in the diagram are as follows:

- Economic and market assumptions: the input of the central assumptions for the economic and market conditions.
- Economic driver: this component simulates the set of basic fundamental variables based on statistical distributions and the assumption set.
- Exposure: specification of the company specific exposure based on the current situation and the assumption set.
- Insurance driver: simulation of claims based on statistical distributions, for various lines of business, on the exposure and on the economic driver output.
- Assets and liabilities: calculation of the gross performance of the assets and liabilities, based on the outcome of economic and insurance drivers, incorporating features of specific asset and liability classes.
- Hedging and reinsurance: calculation of the net performance after the application of such protections.
- Financial model: translation of the asset and liability performance into financial figures and incorporation of provisions, expenses, tax, dividends etc.

There is no standardised approach to these elements. However, there are some common features and minimum levels of detail and sophistication amongst the models we have seen. These are discussed below.

### *Economic driver*

The economic driver models in use vary greatly, but the following are the minimum components:

- Inflation: especially for non-life insurance.
- Interest rates: the simplest versions are restricted to a single rate, but the typical scope reaches from models for a short and a long term rate to models for a full yield curve. Interest rate modelling is of relatively higher importance in the life industry.
- Equity returns: these are commonly captured by modelling a number of stock market indices.

Some larger insurance companies have developed their own models based on models discussed in available research. The main providers of modelling services are consultant companies, large insurance brokers and reinsurance companies. Almost every consultant company that operates in the insurance sector has its own economic driver model. These

range from models closely based on publicly scrutinised models to completely original and proprietary models.

Overall, asset modelling has been discussed more than the liability models, but for most models only high level design features and principles are disclosed, and, considering the difficulty of the modelling task, the models are not well scrutinised.

The interaction of modelling components is also captured. Cascade models are very common, modelling the components in layers, where the dependence is restricted into one direction.

The individual components are models of various types. Economic and financial models based on equilibrium or non-arbitrage principles are used, as well as more statistical and econometric models. The original purpose of most sub-models is not risk assessment; they were models that were designed for valuation, forecasting or descriptive purposes. They also differ in their focus between long-term and short-term durations.

Despite the diversity outlined above, two models appear to be fairly wide-spread. Many interest rate models, both in the life and non-life insurance sectors, are derived from the Vasicek model<sup>4</sup>. At least in the UK, the Wilkie model has been widely used<sup>5</sup>. This was originally designed for actuarial use with a focus on long-term variability.

More elaborate models exist, incorporating multiple countries, exchange rates and GDP. In advanced life insurance companies, there are also some models that incorporated credit risk for bonds. The credit risk is modelled based on bond ratings, assuming transition probabilities between the various grades over time.

### ***Insurance driver and liability model***

The insurance driver, underlying the liability model, is even less standardised than the economic drivers. However, the underlying principles of those models are less versatile than for asset models.

For non-life models, the core is made up by simple loss ratio models and more advanced models that consider both loss count and loss size separately. There is a degree of complexity and non-standardisation involved in the estimation of parameters for specific business lines, in the handling of dependence between lines and on economic variables and in modelling the timing and cash flow effects. Identification of relevant policy details and adequate exposure data varies greatly with the lines of business. Natural perils are sometimes modelled by third parties (e.g. reinsurance brokers) applying specialised models of relatively high sophistication.

In the life insurance models, policy by policy modelling is more common than modelling of an aggregated portfolio. The modelling of life insurance liabilities is more closely related to financial modelling, and the main probabilistic input is provided by the dependence on the economic driver.

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<sup>4</sup> Vasicek, O.A. (1977) An Equilibrium Characterisation of the Term Structure. *Journal of Financial Economics*, Vol. 5.

<sup>5</sup> Wilkie, A.D. (1995) More on a stochastic asset model for actuarial use. *British Actuarial Journal*, 1, 777-964.

## Risk Model Survey

The application and design of risk models in insurance is a wide and heterogeneous area. It is therefore not easy to produce an overview. We sent out a risk model questionnaire to 30 leading insurance and reinsurance groups in Europe. We received twelve responses. In the light of the complexity of the topic and of the relatively small number of responding companies the survey can therefore not claim any statistical significance as a representation of the overall picture. The sample is also biased, as we selected companies that already had a reputation for sophistication and for using quantitative risk models.

The percentage figures cannot be taken as hard numbers that represent the European market-wide use of risk models. But they do demonstrate the heterogeneity of the topic, as well as, perhaps, some distinguishable trends. Also, the responses were generally in line with our experience.

*Question: On a scale of 1 to 5, where 1 is basic and 5 is sophisticated, how do you classify the models in use in your company?*

	1	2	3	4	5
%	0%	0%	42%	58%	0%

The scale of relative sophistication can be understood in terms of theoretically possible model sophistication and in terms of sophistication relative to that currently found in the market. Most of the questioned companies would be expected to be close to representing best market practice, and accordingly, the above result is likely to relate to a theoretically possible sophistication of models. It was clear that all the respondents were aware that their models can be improved and have limitations.

*Question: What do you consider are the limitations of internal risk models?*

	Data	Technology	Number of scenarios tested	Difficulty in quantifying certain risks	Other (please specify)
%	83%	8%	33%	92%	33%

The most commonly cited limitations for the application of more sophisticated models are the lack of data and a generic difficulty in establishing reliable models for certain risks. These two causes are partially related. The data problem is on the one hand a problem in gathering the internal exposure data of the business in a meaningful and efficient manner in order to produce model input. On the other hand this data problem also prevents building sufficient statistical records for model design and parameterisation. In its second form the data issue prevents the development of reliable models for certain risks. Furthermore, there are risks, especially non-financial risks, and risk sources which are not of a quantitative nature and are generically hard to model. Many operational risks would fall into this category.

Question: *What do you consider to be the benefits of internal risk models?*

Respondents mentioned the following benefits:

- quantification and comparison of risks, consideration of companies specialties/needs;
- knowledge about our own risk profile;
- steering instrument for accepted risk levels and risk/return;
- comparability in performance in our various group companies, guide for capital allocation, more appropriate than external models;
- quantification of returns for very different business areas/lines;
- improved risk management;
- ability to manage risk more effectively;
- no black box - better fit with internal needs;
- business and company specific risk profile, risk adequate assessment, transparency and acceptance, improved control of management, portfolio effects;
- total perspective on quantifiable risk process of making model yields in risks.

Internal risk models are used for risk management purposes in order to achieve an adequate risk assessment, but also with the objective of performance measurement and to achieve a desired risk and return balance.

*Question: Please indicate for which of the following purposes risk models are applied in your company.*

Key Risk modelling type

- A Deterministic Stress Testing
- B Deterministic Dynamic Financial Analysis (explicit modelling of time, no probabilities)
- C Probabilistic Dynamic Financial Analysis (explicit modelling of time and probabilities)
- D Other Probabilistic/Stochastic Modelling (explicit modelling of probabilities, but not of time)
- N None
- O Other

	Business mix, diversification strategy	Asset allocation (investment policy)	Pricing Strategy	Performance measurement	Capital management	Capital allocation	Pricing	Product development
A	25%	25%	17%	17%	17%	25%	17%	17%
B	33%	25%	42%	33%	33%	25%	58%	58%
C	33%	58%	25%	33%	58%	50%	33%	33%
D	17%	42%	17%	17%	8%	25%	25%	8%
N	8%	17%	17%	17%	8%	8%	8%	25%
O	17%	0%	0%	0%	0%	0%	0%	0%

	Provisioning	Determination and evaluation of insurance protections	Determination and evaluation of financial hedges	Matching	Capital adequacy	Determination of overall risk profile	Other
A	25%	25%	25%	17%	42%	25%	0%
B	42%	8%	8%	8%	25%	25%	0%
C	42%	42%	58%	33%	58%	58%	0%
D	25%	8%	17%	17%	25%	25%	0%
N	17%	33%	25%	25%	8%	17%	0%
O	0%	0%	0%	0%	0%	0%	0%

Even though we are only dealing with twelve companies, a number of observations can be made that (in line with our experience) bear some relevance for the wider market:

- clearly, risk models are used to assist a wide range of business purposes;
- some companies show a clear preference for a specific modelling type and approach, but nine out of the twelve companies are using different approaches for different purposes, and five even apply a mixture of approaches and models to one and the same purpose;
- across companies we can observe a great variety for one and the same purpose. This represents differences in sophistication, but also differences in modelling cultures. This supports the belief that risk models in the insurance sector are widely used, but with very little consistency between companies;
- there seems to be a clear trend towards the use of probabilistic DFA models for the purpose of capital adequacy and overall risk profile assessment, demonstrating that

holistic, aggregate view risk models are seen to be most appropriate for these tasks. The parallel application of different model approaches, as demonstrated in the table, provides a serious challenge for the development of holistic, aggregate view risk models;

- each category contains a vast number of different models, which could themselves be categorised in further sub-categories. The small number of 'other model types' responses indicates that the companies were comfortable in using the proposed categories, the differentiation in the responses also indicates that the companies do think along these categories and that the distinction matters to them;
- the absence of any answer under 'other purposes' also indicates that the list of purposes fairly exhausts the purposes for which risks models are actually used.

*Question: Which of the following risks do you consider in your quantitative risk assessment?*

	Pure underwriting	Reinsurance	Investment	Matching	Lapses	Jurisdictional and legal	Market value fluctuation
%	75%	58%	92%	67%	50%	25%	83%

	Social changes	Inflation rate	Exchange rates	Credit	Operational	Liquidity	Expenses
%	0%	58%	67%	58%	42%	50%	67%

	Provisioning	Market changes	Environmental changes	Economic cycle	Interest rates	Technological changes
%	67%	42%	0%	42%	92%	0%

- The table of risks which are considered in the quantitative risk assessment reflects the effect of the importance of the risk and the difficulty of modelling it. Most respondents consider the financial risks of underwriting, investment, market values and interest rates. Specific business risks such as market changes, lapses and provisioning, as well as some general economic risks such as the economic cycle, inflation rates and exchange rates are considered in 40% to 60% of cases. Risks which are difficult to quantify such as social, environmental and technological changes are not considered at all in the quantification.

*Question: Do you use an ...?*

	Integrated aggregate risk model, fed by separate sub-models	Stand-alone aggregate risk model, not integrated with sub-models	Aggregate risk view extracted from non-integrated sub-models without use of an aggregate risk model	No aggregate risk view
%	17%	25%	25%	33%

Capturing the total risk of an entity requires modelling all relevant individual classes and the aggregated performance of these classes. For capital adequacy and risk profile issues, an aggregate risk view, however formed, is essential. The table above groups the companies into four groups in terms of ability and approach:

- four out of the twelve respondents do not or are not able to produce an aggregated risk profile.
- the ‘ideal’ solution is an integrated system, which calculates aggregate risk using input and results from more specific risk sub-models. Only two respondents are able to calculate aggregate risk in this manner.
- another three respondents apply a stand-alone aggregate model, which is not connected to the sub-systems.
- the remaining three respondents do not apply a specific aggregate model, but use the results extracted from non-integrated sub-models to produce a total risk profile.

A clear obstacle to integration is the parallel application of different modelling approaches, which are difficult to reconcile. In addition, combining risk models is more than just adding the results together. A coherent combined model requires that the interaction of risks in the models is taken into account and that risks which are relevant for various sub-models are modelled coherently. The task of model integration has therefore an element of exponential complexity to it, and is difficult in itself.

The table shows two alternative ways of calculating an aggregate view of risk without the use of an integrated aggregate model. The solution that uses a stand-alone aggregate model has the advantage that the effects of risk interaction and diversification can be assessed by a model. Risks aggregate in a complex way and the application of advanced aggregate models is required for valid modelling. The disadvantage of this approach is that the model is not integrated with more specific sub-systems. Important features that are captured in the sub-systems can be missed out or can only be modelled approximately. There is room for incoherence between the models and for subjective adjustments in the overall model.

The alternative of using sub-model results and aggregating them without using a model has the advantage that a single risk category is not modelled in two different ways. The drawback is that a valid aggregation requires an advanced model. Any alternative aggregation gives room for subjective adjustments and approximations in the aggregation.

Question: If you use non-integrated models, do you have separate models for ...?

	Individual lines of business, classes or products?	Asset risks?	Economic risks?	Market models for competition or customers?	Reinsurance evaluation?	Financial hedges?
%	58%	42%	33%	0%	25%	17%

This table gives more insight into the areas where specific sub-models exist. Clearly most respondents see the need to have specific risk models for the different insurance lines followed by specific asset models.

Question:

	Do you have resources assigned to risk management?		What modelling tools are used in the process?			Do you use external consultants to assist in the quantitative risk assessment?	
	Yes	No	In-house development	External models and software, operated by in house resources	External models and software, operated by external resources	Yes	No
%	83%	17%	100%	58%	25%	50%	50%

There is a clear trend to assign modelling resources to support the risk modelling functionality.

The respondents clearly tend to develop their risk modelling capabilities in-house. This is a clear sign that the companies assign importance to working with adequate models, which they fully understand and control. It also reinforces the notion of a very small degree of industry-wide standardisation. Where external models are used the respondents prefer to operate them by in-house resources rather than to depend on external resources.

## **Requirements for model recognition for supervisory purposes in the banking sector**

In the course of developing a system of using banks' own internal models for determining regulatory capital requirements, various criteria have been set out before models can be used by banks. These criteria are general in nature and therefore could be equally applicable for supervisory use in the insurance sector. The key requirements are:

### ***A quantified measure of risk***

The model gives a quantified measure of risk, which is calculated using objective parameters.

### ***Integral to risk management***

It is regarded as essential that the model used for regulatory purposes is the same model used continually for risk management purposes; i.e. a separate model is not developed purely for regulatory purposes.

### ***Independent back testing***

Once it has been accepted for live usage, a model should be subject to back testing to ensure that its capabilities remain subject to the original specification and the model is performing as expected. This process should be carried out by persons independent of the day to day usage of the model to ensure the integrity of the validation process.

These three key factors are the basis for the banking approach to model use for regulatory capital purposes. Modelling approaches which cannot meet these criteria are not generally used for regulatory capital.

### ***Senior management responsibility***

Senior management "buy-in", and responsibility for the modelling process – from initial development, to its practical daily use, and to its verification and any modification or development of the model. It is not regarded as sufficient to leave the subject to "back room technicians".

### ***Limitations of the model***

Equally important to understanding the capabilities of a model is the understanding of its limitations and what it will not do. This topic is as important for senior management as it is for immediate users of a model.

### ***Independent check and challenge***

As a model is developed it should be subject to independent checks and challenges to provide senior management (and supervisors) with some comfort that a review, independent of those responsible for the use of the model or its development has been carried out. This might be performed by either the internal or external audit function, or if it is sufficiently independent, the risk analysis and assessment department.

### ***Materiality and comprehensiveness***

In practice it is unlikely that any model will adequately cover every conceivable aspect of measuring the risks of the particular business line. It is however essential that all material risks are covered; part of the supervisory scrutiny involves an assessment of which risks are material and therefore should be included and which risks might be regarded as immaterial and omitted.

### ***Proven track record***

A model should not be used for risk management or supervisory purposes without thorough prior testing. It should therefore be used in a test environment to ascertain its acceptability for the purposes intended before being used in a live environment.

### ***Stress testing***

Whilst back testing is used to confirm the validity of a model in normal market conditions, stress testing is regarded as important to assess the capabilities of the model in any abnormal conditions which might occur in the future. The process of stress testing should occur on a regular basis and should be updated regularly to take account of likely market developments.

### ***Maintenance***

Once developed models rarely remain unchanged, but are subject to regular refinement and updating. This process needs to be subject to senior management and regulatory review and to stringent controls. In practice, supervisory authorities need to determine what type of amendments they will accept without a formal reappraisal of a model from scratch; which amendments will be accepted as part of the normal development of a model, and which should be treated as so fundamental that the model has effectively been rewritten and must be reviewed again as though it were a new application for model recognition.

### ***Management and measurement***

Most supervisors draw a distinction between risk management and risk assessment in the context of model recognition. Risk management encompasses the environment in which its model operates and the control systems to which it is subject. Risk measurement on the other hand, covers the technical performance of the model and its predictive powers. In general, risk management is more important than risk measurement. Clearly, a first class model operating in a first class control environment is to be preferred. However, where this is not possible, it is possible to have a slightly deficient model operating in a first class control environment; but highly inadvisable to accept a first class model operating in a control environment which is deficient. This aspect is particularly important when considering the use of models which have been developed centrally and are now being used in branches and subsidiaries overseas.

### Assets allowed to cover technical provisions (Article 21, Third Life and Non-Life Directives)

<b>Investments</b>	<ul style="list-style-type: none"> <li>■ Debt securities, bonds, money and capital market instruments;</li> <li>■ loans<sup>6</sup>;</li> <li>■ Equities and other variable yield participations;<sup>7</sup></li> <li>■ Units in undertakings for collective investment in transferable securities and other investment funds;</li> <li>■ Land, buildings and immovable property rights.</li> </ul>
<b>Debt and claims</b>	<ul style="list-style-type: none"> <li>■ Amounts owed by reinsurers, including reinsurers' shares of technical provisions;</li> <li>■ Deposits with and debts owed by ceding undertakings;</li> <li>■ Debts owed by policyholders and intermediaries arising out of direct and reinsurance operations;</li> <li>■ Advances against policies (Life Directive only);</li> <li>■ Claims arising out of salvage and subrogation (Non-Life Directive only);</li> <li>■ Tax recoveries;</li> <li>■ Claims against guarantee funds.</li> </ul>
<b>Others</b>	<ul style="list-style-type: none"> <li>■ Tangible fixed assets, other than land and buildings, valued on a basis of prudent amortisation;</li> <li>■ Cash in bank and in hand, deposits with credit institutions and any other bodies authorised to receive deposits;</li> <li>■ Deferred acquisition costs;</li> <li>■ Accrued interest and rent, other accrued income and prepayments;</li> <li>■ Reversionary interests (Life Directive only).</li> </ul>

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<sup>6</sup> Loans, whether to undertakings, to State authorities or international organisations, to local or regional authorities or to natural persons, may be accepted as cover for technical provisions only if there are sufficient guarantees as to their security, whether these are based on the status of the borrower, mortgages, bank guarantees or guarantees granted by insurance undertakings or other forms of security.

<sup>7</sup> Transferable securities which are not dealt on a regulated market can only be included under the Non-Life Directive if they can be realised in the short-term.

### Examples of assets prohibited from being used to cover technical provisions

<b>Denmark</b>	Tax assets (non-life) As per Directives
<b>France</b>	As per Directives, except that new regulations to be published shortly will prohibit investments in certain derivatives.
<b>Italy</b>	As per Directives
<b>Netherlands</b>	As per Directives
<b>Spain</b>	Debts (other than deposits) owed by the ceding undertaking; Debts owed by policy-holders and intermediaries arising out of direct insurance and reinsurance operations; Advances against policies (life); Claims arising out of surrender and subrogation (non-life); Claims against guaranteed funds; Tangible fixed assets, other than land and buildings; Deferred acquisition costs; and Reversionary interests (life).
<b>Sweden</b>	Commodities; Deferred acquisition costs; Accrued income; Prepayments.
<i>Source: KPMG</i>	

### **Valuation of assets rules (Article 21, Third Non-Life Directive)**

Assets covering technical provisions shall be valued net of any debts arising out of their acquisition.

All assets must be valued on a prudent basis, allowing for the risk of any amounts not being realisable. In particular, tangible fixed assets other than land and buildings may be accepted as cover for technical provisions only if they are valued on the basis of prudent amortisation.

Derivative instruments such as options, futures and swaps in connections with assets covering technical provisions may be used insofar as they contribute to a reduction of investment risks or facilitate efficient portfolio management. They must be valued on a prudent basis and may be taken into account in the valuation of the underlying assets.

Transferable securities which are not dealt in on a regulated market may be accepted as cover for technical provisions only if they can be realised in the short term.

Debts owed by and claims against a third party may be accepted as cover for technical provisions only after deduction of all amounts owed to the same party.

The values of any debts and claims accepted as cover for technical provisions must be calculated on a prudent basis, with due allowance for the risk of any amounts not being realisable. In particular, debts owed by policyholders and intermediaries arising out of insurance and reinsurance operations may be accepted only insofar as they have been outstanding for not more than three months.

Where the assets held include an investment in a subsidiary undertaking which manages all or part of the insurance undertaking's investments on its behalf, the home Member State must, when applying the rules and principles laid down in Article 21 of the Directive 92/49/EEC, take into account the underlying assets held by the subsidiary undertaking; the home Member State may treat the assets of other subsidiaries in the same way.

Deferred acquisition costs may be accepted as cover for technical provisions only to the extent that that is consistent with the calculation of the technical provision for unearned premiums.

### Examples of unrestricted assets for use in covering technical provisions

<b>Denmark</b>	<ul style="list-style-type: none"> <li>■ Bonds or debt instruments issued or guaranteed by the government or regional authorities within Zone A;</li> <li>■ Listed bonds issued by international organizations, which have at least one of the Member States of the EU as a member; and</li> <li>■ Debts secured on policies of insurance (not higher than surrender value).</li> </ul>
<b>France</b>	<ul style="list-style-type: none"> <li>■ Use of bonds is unrestricted (no maximum nor minimum limits).</li> </ul>
<b>Netherlands</b>	<ul style="list-style-type: none"> <li>■ As per the Directives.</li> </ul>
<b>Spain</b>	<ul style="list-style-type: none"> <li>■ Units in undertakings for collective investments in transferable securities and other investment funds;</li> <li>■ Deposits made with ceding reinsurers;</li> <li>■ Participation of reinsurers in the undertaking's provision for claims;</li> <li>■ Amounts due from the tax authorities;</li> <li>■ Securities issued by an international organisation of which an EEA country is member, or by the State, regional or local government or by State-owned entities; and</li> <li>■ Any type of asset, when the risk of the investment is borne by the policy holders (unit-linked products).</li> </ul>
<b>Sweden</b>	<ul style="list-style-type: none"> <li>■ Bonds and other debt securities guaranteed by governments and local authorities of a Zone A country or by an international organisation. Also debts owed by these bodies in respect of an insurance policy;</li> <li>■ For a captive, debts in respect of an insurance policy owed by a group company;</li> <li>■ Debts in respect of premium in non-life insurance;</li> <li>■ Debts secured on life insurance policies; and</li> <li>■ Tax recoveries.</li> </ul>

<p><b>United Kingdom</b></p>	<ul style="list-style-type: none"> <li>■ Securities, deposits, loans and debts issued/guaranteed by the government or local authorities of a Zone A country;</li> <li>■ Any loan to, or deposit with, an approved financial institution. An approved financial institution is the central bank of an EEA state or certain supranational institutions;</li> <li>■ Debts secured on policies of insurance (not higher than surrender value);</li> <li>■ Rights under a contract of reinsurance;</li> <li>■ Subrogation or salvage rights (general insurance);</li> <li>■ Debts in respect of premiums;</li> <li>■ Shares in or debts from a dependent;</li> <li>■ Holdings in a scheme falling within Council Directive 85/611/EEC (UCITS); and</li> <li>■ Deferred acquisition costs (general insurance).</li> </ul>
<p><i>Source: KPMG</i></p>	

## **Summary of the principles set out in Article 22 of Directive 92/49/EEC that Member States should apply when setting more limitative restrictions for other assets**

Assets covering technical provisions must be diversified and spread in such a way as to ensure that there is no excessive reliance on any particular category of asset, investment market or investment.

Investment in particular types of asset which show high levels of risk, whether because of the nature of the asset or the quality of the issuer, must be restricted to prudent levels.

Limitations on particular categories of asset must take account of the treatment of reinsurance in the calculation of provisions.

Where the assets held include an investment in a subsidiary undertaking which manages all or part of the insurance undertaking's investments on its behalf, the home Member State must, when applying the rules and principles laid down in the Article, take into account the underlying assets held by the subsidiary undertaking. The home Member State may treat the assets of other subsidiaries in the same way.

The percentage of assets covering technical provisions which are the subject of non-liquid investments must be kept to a prudent level.

Where the assets held include loans to or debt securities issued by certain credit institutions, the home Member State may, when applying the rules and principles laid down in this Article, take into account the underlying assets held by such credit institutions. This treatment may be applied only where the credit institution has its head office in a Member State, is entirely owned by that Member State and/or that State's local authorities and, its business, according to its memorandum and articles of association, consists of extending, through its intermediary, loans to or guaranteed by the State or local authorities or loans to bodies closely linked to the State or to local authorities.

In the context of the detailed rules laying down the conditions for the use of acceptable assets, the Member State shall give more limitative treatment to:

- Any loan unaccompanied by a bank guarantee, a guarantee issued by an insurance undertaking, a mortgage or any other form of security, as compared with loans accompanied by such collateral;
- UCITS not coordinated within the meaning of Directive 85/611/EEC and other investment funds, as compared with UCITS coordinated within the meaning of that Directive;
- Securities which are not dealt in on a regulated market, as compared with those which are;
- Bonds, debt securities and other money and capital-market instruments not issued by States, local or regional authorities or undertakings belonging to Zone A as defined in Directive 89/647/EEC, or the issuers of which are international organisations not numbering at least one Community Member State among their member, as compared with the same financial instruments issued by such bodies.

### Examples of additional asset restrictions imposed by Member States

<b>Denmark</b>	Assets are split into two categories, gilt-edged and non gilt-edged. The former category, being assets such as bonds guaranteed by governments, must form at least 30% of the total assets covering technical provisions.																								
<b>France</b>	<p>There are two levels of limitations: limits by category and limits in connection with dispersion (concentration):</p> <table border="1"> <thead> <tr> <th></th> <th>Upper limit by category</th> <th>Upper limit by individual investment</th> </tr> </thead> <tbody> <tr> <td>State-issued or state guaranteed securities</td> <td>Unlimited</td> <td>Unlimited</td> </tr> <tr> <td>Listed bonds</td> <td>Unlimited</td> <td>Unlimited</td> </tr> <tr> <td>SICAV or FCP bonds (mutual funds)</td> <td>Unlimited</td> <td>10%</td> </tr> <tr> <td>Other listed bonds</td> <td>Unlimited</td> <td>5%</td> </tr> <tr> <td>Shares</td> <td>65%</td> <td>5%</td> </tr> <tr> <td>Loans</td> <td>10%</td> <td>5%</td> </tr> <tr> <td>Land and buildings or non quoted real estate companies</td> <td>40%</td> <td>10%</td> </tr> </tbody> </table>		Upper limit by category	Upper limit by individual investment	State-issued or state guaranteed securities	Unlimited	Unlimited	Listed bonds	Unlimited	Unlimited	SICAV or FCP bonds (mutual funds)	Unlimited	10%	Other listed bonds	Unlimited	5%	Shares	65%	5%	Loans	10%	5%	Land and buildings or non quoted real estate companies	40%	10%
	Upper limit by category	Upper limit by individual investment																							
State-issued or state guaranteed securities	Unlimited	Unlimited																							
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SICAV or FCP bonds (mutual funds)	Unlimited	10%																							
Other listed bonds	Unlimited	5%																							
Shares	65%	5%																							
Loans	10%	5%																							
Land and buildings or non quoted real estate companies	40%	10%																							
<b>Italy</b>	<p>Participations in subsidiaries and associates is restricted to lower of:</p> <ul style="list-style-type: none"> <li>■ 25% of assets backing technical provisions for non-life companies (35% for life companies)</li> <li>■ 20% of the capital of the company</li> </ul>																								
<b>Sweden</b>	<p>Aggregate of:</p> <ul style="list-style-type: none"> <li>■ deposits with a Swedish or foreign bank; and</li> <li>■ bonds or other debt securities issued by a credit institution, a securities company or a public company; is restricted to 75% of technical provisions net of reinsurance.</li> </ul> <p>Further, not more than 50% of this category can be held on bonds or other debt securities issued by a public company.</p>																								
<b>United Kingdom</b>	Holdings in any single authorised or recognised unit trust scheme is restricted to 5% of technical provision net of reinsurance.																								
<i>Source: KPMG</i>																									

## Relevant credit rating agencies and investment grade ratings used in the UK

The determination of qualifying debt instruments for the calculation of specific interest rate risk can be based upon credit ratings. The ratings agencies used for this purpose and the rating deemed to be investment grade are listed below:

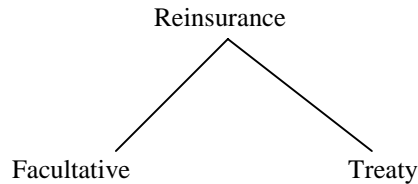
### Credit rating agencies and investment grade ratings used in the UK

Relevant rating agencies	Minimum ratings	
	Securities	Money market obligations
<b>For all issuers</b>		
Moody's Investors service	Baa3	P3
Standard & Poor's Corporation	BBB-	A3
FITCH IBCA	BBB-	F-3
<b>For all banks, building societies and parent companies and subsidiaries of banks</b>		
Thomson Bankwatch	BBB-	TBW3
<b>For Canadian issuers</b>		
Canadian Bond Rating Service	B++ low	A-3
Dominion Bond Rating Service	BBB low	R-2
<b>For Japanese issuers</b>		
Japan Credit Rating Agency, Ltd	BBB-	J-2
Japan Rating and Investment Information Inc	BBB-	a-2
Mikuno & Co	BBB	M-3
<b>For United States issuers</b>		
Duff & Phelps, Inc	BBB-	3

## Description of certain reinsurance arrangements

### *Main types of reinsurance - Facultative business and treaty business*

Reinsurance can be arranged between the insurer and the reinsurer, in respect of individual risks or in respect of a group of risks. Facultative reinsurance relates to one specific risk. Treaty reinsurance relates to a group of risks.



Under facultative business the reinsurer receives an offer from the insurance company to underwrite a risk. The offer determines the nature of the risk, start and end of the insurance period, the sum insured and the premium. The reinsurance company can accept the risk offered by the ceding company, in full or in part, as a proportion or as a fixed sum. This type of agreement is designed to enable the insurer to lay off the following features of an individual risk:

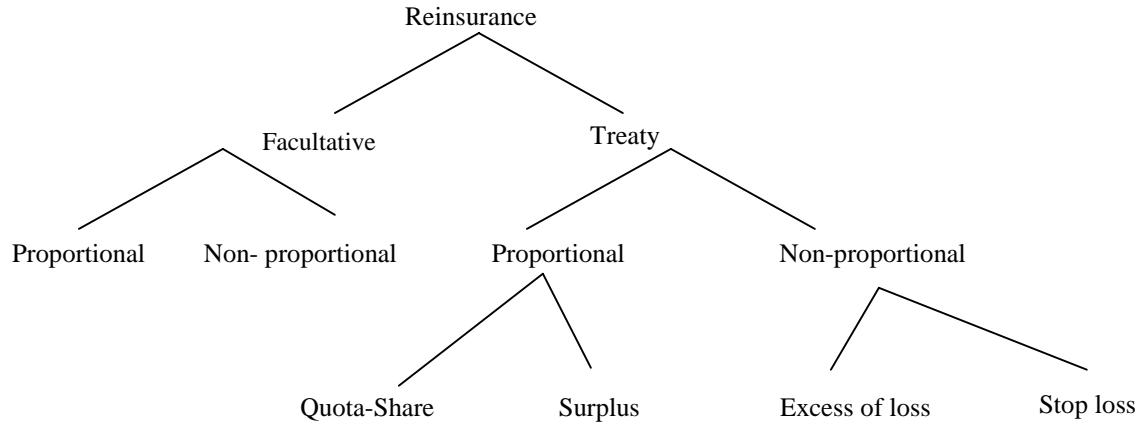
- size (personal accident cover);
- type or conditions (eg chemical plants particularly prone to explosion);
- likelihood of occurrence (such as the insurance of a satellite).

There is also a relatively unusual type of contract known as facultative obligatory cover. Under this type of arrangement the cedant chooses which risks are to be ceded and the reinsurer is obliged to accept them.

Under treaty reinsurance the cedant (the company taking out the reinsurance cover) agrees to cede, and the reinsurer agrees to accept, all business written by the cedant which falls within the specific terms of the contract (the treaty) that they have entered into. Individual risks are not negotiated.

### ***Proportional and non-proportional business***

Both facultative and treaty contracts may be concluded on a proportional or non-proportional basis.



Under proportional reinsurance the reinsurer agrees to cover a proportionate share of the risks ceded. Premiums and losses will follow that of the ceding company.

Non-proportional cover allows the insurer to retain risks up to a certain predetermined limit, whether on a risk by risk basis or in aggregate (risks are pooled to determine whether or not the limit has been exceeded). Non-proportional reinsurance arrangements play an important role in an insurer's risk management process. Arrangements of this nature, if constructed carefully, can smooth an insurer's results.

### ***Proportional treaty reinsurance***

#### *Quota-share*

The quota share contract is the simplest of all forms of treaty reinsurance. The reinsurer agrees to reinsure a fixed proportion of every risk accepted by the ceding company, and so shares proportionately in all losses. In return, the reinsurer shares the same proportion of all direct premiums (net of return premiums), less the agreed ceding commission. The treaty will specify the class(es) of insurance covered, the geographical limits and any other limits or restrictions (such as any specific types of risks or perils excluded from the treaty). The treaty usually provides that the ceding company will automatically cede the risk while the reinsurer will correspondingly accept the agreed share of every risk underwritten that falls within the contract.

#### *Surplus*

Similar to quota-share, surplus treaty is a form of proportional reinsurance by which the insurer accepts a certain share of each individual risk, receiving an equivalent proportion of the gross premium (less reinsurance commission) and paying the same proportion of all claims.

The basic difference between the two is that under surplus treaties, the cedant only reinsures that portion of the risk that exceeds its own retention limit while under quota share arrangement, there are no retention limits. Quota-share reinsurance cedes a fixed percentage for all risks whereas for surplus this varies for each risk. Furthermore, quota share reinsurance can be used for any class of insurance whereas surplus

treaties can only operate for property and those other classes of insurance where the insurer's potential maximum liability is categorically expressed.

### ***Non-proportional treaty reinsurance***

#### *Excess of loss reinsurance*

Under a contract of excess of loss reinsurance, the reinsurer only becomes liable once a claim exceeds the retention of the ceding company (the retention is also known as the deductible). The treaty will usually set an upper limit on the reinsurer's liability. Any further element of the claim is borne by the ceding company or may be covered by further layers of excess of loss reinsurance.

#### *Stop loss reinsurance*

A stop loss treaty is a form of non-proportional reinsurance which limits the insurer's loss ratio, (the ratio of claims incurred to premium income). It may apply either to a particular class of business or to the insurer's total result. For example the reinsurer may be liable to pay for claims once a loss ratio of 110% of net premium income is reached, up to a maximum limit of a 150% loss ratio. Should the loss ratio exceed 150% any further losses are borne by the insurer.

#### *Reciprocity Business*

This is the reciprocal exchange of reinsurance business. Reinsurance companies might seek an exchange of reinsurance business in return for their own ceded business, particularly when their own business is profitable. Reasons for reciprocity business can be the company's desire to obtain a more diversified business, to increase their net premium income by adding to premiums retained from their direct business the premiums for reinsurance business. Reciprocity business in these cases can be understood as traditional reinsurance business. However, reciprocity business can also be understood as ART business if the reinsurance assumes both profitable and unprofitable business from the same ceding company with profits and losses offsetting each other.

### ***Factors determining the risk profile of reinsurance contracts***

The risk that the reinsurance company is exposed to when writing a reinsurance contract depends, amongst others, upon the contractual features of the respective contract. The following provisions can increase or decrease the risk:

- **Sliding-Scale Commission Rate:** by using sliding-scale commission rates the reinsurance company can reward a ceding company for ceding profitable business and conversely penalise a cedant for poor experience. This gives the ceding company an incentive for underwriting (and ceding) high quality business;
- **Profit Commission:** by paying a profit commission in addition to a flat commission the reinsurance company can reward the ceding company for a better than average experience. In the case of a poor experience the reinsurance company pays lower profit commissions partly offsetting the higher loss payments;
- **Loss Participation Clauses:** by using loss participation clauses the assuming company can penalise the ceding company if a treaty's loss experience deteriorates. Under these provisions the reinsurer can recover expenses from the ceding company;

- Profit sharing: under profit sharing agreements the insurance company returns at regular intervals a varying percentage of the amount by which net premiums exceed claims.

Overall, the risk the reinsurer is exposed to depends on the overall reinsurance program of the ceding company. For example a reinsurance company writing a quota-share contract is exposed to a higher risk if the quota-share is not accompanied by an excess-of-loss treaty (compared to a quota-share that is accompanied by an excess-of-loss.)

## **The Risk Based Capital (RBC) concentration adjustments**

The NAIC<sup>8</sup> RBC charges are not based on an explicit capital definition and they are embedded in a consistent probabilistic framework. It is therefore not possible to assess how appropriate the concentration adjustments are, as there are no criteria for such an assessment. The adjustments (as almost all design features of the NAIC RBC methodology) are therefore arbitrary to a certain degree.

### ***Covariance formula***

The covariance formula ensures that the capital charges from individual risk categories are not simply added up. This behaviour is in line with the fact that the risk categories are not completely dependent, i.e. that there is some diversification effect between the risk categories.

Whether the diversification is appropriately accounted for has been debated<sup>9</sup>. In the light of the remarks on arbitrariness it is not surprising that no conclusive answer can be found.

The covariance formula can actually be embedded into a probabilistic framework, but not without making further (and unrealistic) assumptions.

### ***Concentration adjustments for provisions and underwriting***

The capital charge for provision and underwriting risk will increase the more the underwriting is concentrated in a few classes. Whether the variation of the charges is appropriate is questionable. Apart from arbitrariness the formula also suffers from the fact that it can penalise an insurer who grows his major line of business, which might be well diversified in itself. This conflicts with the above mentioned diversification by numbers. It is also not in line with the usual methodology of scaling factors down when size increases.

### **Bond size adjustment and asset concentration factor**

The capital charges decrease the more investments are spread. Apart from this behaviour the above criticism of arbitrariness applies.

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<sup>8</sup> National Association of Insurance Commissioners

<sup>9</sup> For a detailed discussion see 'NAIC Property/Casualty Insurance Company Risk-Based Capital Requirements' by Sholom Feldblum

## Other existing international accounting standards (IAS)

There are currently 34 IAS in existence, covering a range of topics. The most significant of the existing IAS for insurance companies is IAS 39, which is discussed in section 8.3. Other IAS that may require detailed consideration are listed below. Other IAS may need to be considered depending on the individual circumstances of the company, but we believe these IAS will need to be considered for the majority of companies.

- IAS 12      Income Taxes;
- IAS 19      Employee Benefits;
- IAS 32      Financial Instruments: Disclosure and Presentation;
- IAS 37      Provisions, Contingent Liabilities and Contingent Assets;
- IAS 38      Intangible Assets;
- IAS 40      Investment Property.

IAS 30 (Disclosures in the Financial Statements of Banks and Similar Financial Institutions) currently only applies to banks. There is an ongoing project to update the Standard in order to help provide information needed to properly assess the financial position, financial performance, and cash flows of banks and other entities that carry out deposit-taking, lending, or securities business activities. At its meeting in November 2001 the Board decided to restrict the scope of this project to a pure activity-based approach extending to all entities that carry out deposit-taking, lending, or securities business activities. The intention is to have an exposure draft available for comment during the third quarter of 2002, with the aim of issuing a final standard in 2003. At this stage, we do not have any details about how this will apply to insurance companies. For this reason, we are not currently in a position to comment on the possible implications for insurance companies arising from the revision to IAS 30.

### *IAS 12: Income Taxes*

IAS 12 requires recognition of deferred tax assets or liabilities for all temporary differences between the carrying amount of an asset or liability in the balance sheet and its carrying amount for tax purposes. A deferred tax asset should be recognised for unused tax losses or tax credits to the extent that it is probable that future taxable profit will be available against which these items can be utilised. No deferred tax liabilities have to be recognised for temporary differences which arise from goodwill for which amortisation is not deductible for tax purposes.

Deferred tax assets or liabilities should be measured at the tax rates that are expected to apply to the period when an asset is realised or the liability is settled, based on tax rates (and tax laws) that have been enacted or substantively enacted by the balance sheet date. Current tax and deferred tax movements should be recognised as income or an expense and included in the net profit or loss for the period, except to the extent that the tax arises from a transaction which is directly recognised in equity or in a business combination that is an acquisition.

The impact of the application of IAS 12 on the financial statements will depend on the tax legislation in force in each Member State. Significant deferred tax liabilities may arise where financial assets are measured at fair values for IAS purposes, but not for tax purposes or where there is a significant level of prudence in the valuation of technical provisions. Where new deferred tax assets arise, a decision will be needed as to whether these should be allowed to cover liabilities for solvency monitoring purposes.

### ***IAS 19: Employee Benefits***

IAS 19 has to be applied in accounting for employee benefits which include:

- short term employee benefits, such as wages and paid annual leave. These expenses are recognised (at the expected amount on an undiscounted basis) as incurred;
- post-employment benefits are arrangements which provide benefits after retirement of the employee. Examples are pension plans, post-employment life insurance and post-employment medical care. These are discussed below;
- other long-term employee benefits, such as long-term compensated absences. These have to be measured in the same way as defined post-employment benefits (see below), except that the use of the so-called corridor method is not allowed;
- termination benefits are benefits to which an employee is entitled following early termination of his employment by the employer. These should be provided for when the enterprise is demonstrably committed to the termination. The provision should be discounted if it will not be incurred within 12 months of the balance sheet date;
- equity compensation benefits. IAS 19 only contains disclosure requirements for these. However, share based payments is one of the priority issues on the agenda of the IASB;

Liabilities have to be recognised for legal or contractual obligations and constructive obligations that arise from the enterprise's informal practices and where, for example, a change in these practices would cause unacceptable damage to its relationship with employees.

#### *Post-employment benefits*

IAS 19 deals with defined contribution and defined benefit plans.

##### ■ Defined contribution plans

The employer is only obliged to contribute specified payments to a separate fund while the employee is employed by it. There are no post employment obligations on the employer.

##### ■ Defined benefit plans

These are characterised by the fact that the employer has an obligation to provide agreed benefits to the employee. The employer is therefore exposed to actuarial and investment risk.

The obligation has to be calculated using actuarial techniques and best estimate assumptions, and is discounted to reflect the timing of benefit payments. The liability is reduced by any plan assets (as defined) such as may arise where the employer contributes to a separate long-term employee benefit fund. Plan assets have to be measured at fair value, subject to the so called corridor method (see below) being applied.

Actuarial gains or losses will arise from changes in actuarial assumptions and experience adjustments. These do not need to be recognised until they exceed the greater of 10% of the present value of the defined benefit obligation and 10% of the fair value of the related plan assets. When this “corridor” is exceeded the company has to amortise the excess over the average remaining working life of the employees participating in that plan, starting in the next period. This is known as the “corridor method”. However, a company may adopt an earlier systematic recognition of actuarial gains and losses if it wishes.

IAS 19 may result in significant balance sheet provisions which will reduce the insurer’s equity. Where assets are created, a decision will be needed as to whether they will be accepted to cover liabilities for solvency monitoring purposes.

### ***IAS 32: Financial Instruments: Disclosure and Presentation***

As its title suggests, this standard is about disclosure and presentation in the financial statements. IAS 39 deals with valuation and measurement matters and this standard is therefore of greater interest from a supervisory perspective. One of the main requirements of IAS 32 is that the classification of financial instruments should follow their substance rather than their legal form. Offsetting on the balance sheet is only permitted if the holder of the financial instrument is legally entitled and intends to settle on a net basis.

The disclosures required are set out in paragraph 47 and require:

*“For each class of financial asset, financial liability and equity instrument [amortised cost and fair value categories are to be kept separate for this purpose], both recognised and unrecognised, an enterprise shall disclose:*

- (a) information about the extent and nature of the financial instrument, including significant terms and conditions that may affect the amount, timing and certainty of future cash flows; and*
- (b) the accounting policies and methods adopted, including the criteria for recognising the basis of measurement applied”.*

Guidance on the key risks is given in paragraph 43 and these include price risk (defined as currency, interest and market risks), credit risk, liquidity risk and cash flow risk. This can be useful information from a supervisory perspective and is not always given by European insurance companies at present. Disclosure is also required of the fair value of the financial instruments and of any financial assets that are carried at a value that exceeds the fair value.

### ***IAS 37: Provisions, Contingent Liabilities and Contingent Assets***

IAS 37 describes the accounting and disclosure for all provisions, contingent liabilities and contingent assets with the exception of those resulting from financial instruments measured at fair value, executory contracts, insurance contracts with policyholders (to the extent that they arise from the insurance contracts themselves) and those covered by another IAS. This may render this standard of limited application to insurance companies.

#### *Provisions*

Provisions are liabilities where either the timing or the amount is uncertain. They should only be recognised in the balance sheet if an enterprise has a legal or constructive present obligation arising from a past event, where it is probable that the enterprise will be required to settle the obligation and a reliable estimate can be made of the amount involved. If it is not probable that an outflow of resources will take place, then it is a contingent liability and must not be recognised in the financial statements.

Provisions should be included at their 'best estimate' amount. Whenever more than one scenario is likely, measurement will be based on the expected value, being the weighted average of all possible outflows. When the effect of discounting is material, measurement should be on a present value basis. Where there is sufficient objective evidence that a future event that would affect the obligation will occur, it should be taken into account.

Provisions are also required for onerous contracts and certain restructuring costs, but not for future operating losses or deferred maintenance and IAS 37 provides detailed guidance on provisions related to restructuring.

#### *Contingent assets and liabilities*

IAS 37 prohibits the recognition of contingent liabilities and contingent assets in the balance sheet. Contingent liabilities are defined as possible obligations, which will be confirmed by future events or present obligations arising from past events, where an outflow of economic benefits is not probable or the amount of the obligation cannot be measured reliably. To the extent that a related outflow is not remote contingent liabilities have to be disclosed.

The extent of change for individual companies will depend on how close their existing local requirements are to IAS 37. Differences may arise in the measurement criteria, particularly where local GAAP is recognised as prudent. However, as the standard only relates to non-insurance provisions and contingencies, we do not envisage this having a significant effect for most insurance companies, since other issues will be of greater importance.

### ***IAS 38: Intangible Assets***

IAS 38 deals with externally acquired and internally generated intangible assets. Development costs related to internally generated assets have to be recognised as an asset under certain circumstances.

Even if IAS 38 would lead to the recognition of new intangible assets in the financial statements, this would not affect the solvency margin as no value can be assigned to intangible assets for solvency purposes.

### ***IAS 40: Investment Property***

Investment property is described as property (land and/or buildings) held to earn rentals and/or for capital appreciation rather than for own use. IAS 40 permits companies to choose whether to adopt fair value, with changes in fair value recorded in the income statement or cost accounting (with disclosure of the fair value). The policy selected must be applied consistently across the entire investment property portfolio. It should be noted that the DSOP recommends that insurance companies should exercise the fair value option in order to minimise the valuation mismatch between assets and liabilities.

Initially, all investment property should be measured at cost, including transaction charges. Subsequent expenditure should be added to the carrying value only when it is probable that future economic benefits, in excess of those originally assessed, will flow to the business.

If investment properties are recorded at cost, the carrying amount will comprise its purchase price and any directly attributable costs of bringing it to working condition for its intended use. IAS 36 (impairment of assets) applies to investment properties recorded at cost.

If investment properties are recorded at fair value, this should reflect the actual market conditions at the balance sheet date. Measurement at fair values is likely to lead to higher asset valuations and to more volatility on earnings.

## IASB's planned agenda

### *Active projects*

On 31 July 2001, the IASB announced its initial agenda of nine technical projects, which have been divided into three broad categories:

#### *Projects intended to provide leadership and promote convergence*

- Accounting for Insurance Contracts
- Business Combinations
- Performance Reporting
- Accounting for Share-Based Payments

#### *Projects intended to provide for easier application of International Financial Reporting Standards*

- Guidance on First-Time Application of International Financial Reporting Standards
- Activities of Financial Institutions: Disclosure and Presentation

#### *Projects intended to improve existing International Financial Reporting Standards*

- Preface to International Financial Reporting Standards
- Improvements to Existing International Financial Reporting Standards
- Amendments to IAS 39, Financial Instruments: Recognition and Measurement

Of the above list, the projects that are likely to have the most significant impact on insurance companies, and the prudential supervision thereof, are the first and last – insurance contracts and IAS 39 amendments. These are considered in earlier sections of this chapter.

The IAS 39 amendments is intended to clarify the application of IAS 39 based on issues already identified. Ultimately, the longer-term financial instruments project would lead to the replacement of IAS 39 and amendment of IAS 32. The work of the Joint Working Group (JWG) on financial instruments can be seen as a first stage in the work towards an international standard on fair values.

### *Longer term projects (currently inactive)*

In addition to the nine active projects outlined above, the IASB has identified a further 16 topics that may be added to its agenda in the future.

The following proposed projects deal mostly with measurement and could therefore have an impact on the valuation of either insurance assets or liabilities. They are therefore the most likely to be of interest to insurance companies from a supervisory perspective. At this stage, it is not possible to determine the likely impact of any proposed changes. However, the following notes give an indication of the direction in which future IASB projects could move.

### *Accounting measurement*

This project would seek to resolve issues relating to the selection of the appropriate measurement technique for items included in the financial statements. The project could result in amendment of the measurement discussions in the IASB Framework.

### *Accounting for financial instruments, comprehensive project*

This is really the continuation of the work of the Joint Working Group.

### *Definitions of elements of financial statements*

This project would consider the extent of differences between the definitions of the key elements in the existing IASB Framework and national standard setters. This is with a view to determining whether there are any serious impediments to convergence.

This project could have implications for the proposals developed on a replacement solvency margin regime, as there only can be comparability in the calculation if there is consistency in the definition of elements that fall within the calculation.

### *Impairment of assets*

This project would examine a limited number of issues addressed in existing standards on impairment in various jurisdictions. Issues might include the use of impairment triggers, definition of impairment, and reversals of impairment losses. This project could lead to a revision of IAS 36 (Impairment of Assets).

### *Liabilities and revenue recognition*

The project would consider the distinction between liabilities and equity, the basis of recognition of liabilities and the timing of revenue recognition in the financial statements.

### *Revaluations of certain assets*

This would be a limited scope project to ensure that whenever revaluations are permitted, they are measured and reported in a consistent manner.

### Likely categorisation of assets under IAS 39 by insurance companies

Categorisation	Application for insurers
Loans and receivables originated by the enterprise and not held for trading (amortised cost)	<ul style="list-style-type: none"> <li>■ Bank deposits and other loans granted to debtors, including mortgage advances, are likely to be the most significant items included in this category.</li> <li>■ If they are not within the definition of an insurance contract, premium debtors and policy loans are included in this category.</li> </ul>
Held-to-maturity investments (amortised cost)	<ul style="list-style-type: none"> <li>■ Held-to-maturity investments relate to financial instruments such as bonds and loans not originated by the company that have a fixed maturity date. An asset can only be categorised as such if the holding company intends, and is able, to hold the investment to maturity.</li> <li>■ The tainting rule is likely to restrict use of this category, and such investments may be limited to assets covering items such as annuities.</li> </ul>
Financial assets held for trading (fair value)	<ul style="list-style-type: none"> <li>■ This category relates to assets that are acquired with the view to making a short-term profit, and as such most investments are unlikely to be included here. Derivatives, however, are always classified as held for trading and measured at fair value.</li> <li>■ It should be noted that the proposed amendment to IAS 39 would widen the ability of an insurer to designate its investments as trading. This could then be used when, to aid matching of assets and liabilities, it is convenient to use fair value throughout the profit and loss account.</li> </ul>
Available for sale financial assets (fair value)	<ul style="list-style-type: none"> <li>■ Available for sale financial assets are any financial assets that do not fall into any of the other three categories. As can be seen from the above, most insurance companies' portfolios of investments are likely to fall into this category. However, the proposed extension of the trading category may mean that 'trading' becomes the most widely used categorisation once IAS 39 is amended.</li> </ul>
<i>Source: KPMG</i>	

## Financial strength ratings methodologies

### *Standard & Poor's rating methodology*

(Source: European non-life/reinsurance edition – A guide to Analysis of Insurer Financial Strength)

Standard & Poor's (S&P) methodology uses a variety of both quantitative and qualitative information. While much of this rating process is objective, drawing on a range of key performance ratios, it also includes subjective analysis and opinion. This allows S&P to introduce non-financial elements into the analysis in order to assess strategies and prospects for the company in the future.

S&P does endeavour to achieve comparability in spite of different types of insurance companies operating in various countries of domicile with varying accounting standards, reporting requirements and regulatory demands. The subjective techniques allow for adjustment for the individual circumstances of each insurer.

The S&P rating methodology involves detailed analysis in the following key areas:

Industry risk	This looks at the environmental framework in which the insurance company operates.
Business review	This looks at analysis of past and present performance and a review of how the company will perform going forward. It examines: <ul style="list-style-type: none"> <li>■ competitive strengths and weaknesses</li> <li>■ legal and functional structures</li> <li>■ business mix and diversification, life and non-life, and segmentation</li> <li>■ premium growth rates</li> <li>■ total market share of the company</li> <li>■ quality and spread of distribution channels</li> </ul>
Management and corporate strategy	This area is considered critical by S&P despite the fact that it is one of the most subjective areas. The key areas examined are: <ul style="list-style-type: none"> <li>■ financial strategy and risk management</li> <li>■ strategic positioning of the insurer</li> <li>■ operational control and skills</li> </ul>
Operating performance	This is examined in two main areas <ul style="list-style-type: none"> <li>■ analysis of underwriting performance</li> <li>■ overall performance including investment, other income and expenses</li> </ul>
Investment	The key analysis in this area is to see how the investment strategy fits with the company's liability profile and the input of investment return on total company earnings.
Capital adequacy	The analysis is broadly in two areas: <ul style="list-style-type: none"> <li>■ level of capital needed to support the insurance business at a</li> </ul>

	<p>given rating level</p> <ul style="list-style-type: none"> <li>■ structure and quality of capital.</li> </ul> <p>The analysis is performed on a risk-based capital model which analyses these features and develops a capital adequacy ratio. This model is similar to that used by the US National Association of Insurance Commissioners. A summary of the model is included within Appendix 9.2. Risk based capital methods are discussed, in general, in chapter 10.</p> <p>The evaluation also looks at how highly geared an insurer, or insurance group, may be.</p>
Liquidity	<p>The analysis is concentrated in three core areas of liquidity:</p> <ul style="list-style-type: none"> <li>■ underwriting cash flows</li> <li>■ total operating cash flows</li> <li>■ investment portfolio liquidity</li> </ul> <p>The underwriting cash analysis differentiates cash flows between short tail and liability business.</p> <p>Reference is also made to bank loans and overdraft facilities with financial institutions that can provide ready access to liquidity.</p>
Financial flexibility	<p>Analysis in this area is largely qualitative but S&amp;P consider the potential need for liquidity or additional capital in the future, assessing whether future funding needs can be met or may exceed access to this funding.</p>

There is a review process where a panel decides on the rating.

### ***A M Best rating methodology***

(Source: 2000 Best's insurance reports Life/Health and Property/Casualty)

The methodology is very similar between life and non-life business, the areas where there are key differences are commented on below.

The rating is derived from the balance sheet and operating performance. Full ratings are based on quantitative and qualitative analysis. The quantitative analysis involves over 100 financial tests, the relative importance of these depends on the characteristics of the company being assessed. The results of these tests are compared with data for the industry that AM Best prepare. There is a review process where a committee decides on the rating.

The areas analysed are as follows:

#### ***Balance sheet strength***

AM Best make an in depth analysis of all the relationships which contribute to balance sheet strength. These include examination of capitalisation and leverage. The tests applied are different for life and non-life insurers but they aim to give an insight into the strength of the balance sheet and the risks inherent in the company's capital position.

AM Best have a capital adequacy model which integrates many factors to arrive at a comprehensive view of the risk-adjusted capitalisation. This model is similar in many ways to that used by the US National Association of Insurance Commissioners. However it does use some additional information that AM Best get from their questionnaires. The model is also similar to that used by Standard & Poors.

AM Best generally produce consolidated ratings for insurance groups but part of their analysis is to examine all the intra-company financial relationships. The analysis also looks at the characteristics of the capital structure of any holding company.

The analysis includes consideration of the reinsurance arrangements including the extent to which risk is transferred, the security of the reinsurance and the state of the reinsurance market in general.

For life insurers the reinsurance program should provide protection against adverse fluctuations in experience, for non-life insurers the program should provide catastrophe protection and spread risk.

The rating analysis includes an examination of the policy reserves being held. For life insurers this includes reviewing the methodology, assumptions and level of uncertainty. For non-life insurers AM Best make their own estimate of the ultimate loss position. The resulting discounted reserve needed is compared to that actually being held. Any surplus or deficit is carried forward into the Capital Adequacy Model.

The company's assets are analysed to assess the risk of default and the potential impact of any forced sale.

The liquidity of the insurer is assessed. This is done by reviewing the impact of asset and liability cashflows on both normal and stressed scenarios. For life insurers this analysis is more detailed than for non-life insurers due to the policyholder options sometimes included in life insurance policies.

### *Operating performance*

AM Best reviews the last five years of financial performance to assess profitability, figures are adjusted to allow for changes in levels of premium income and mix of business. In addition to examining statutory profitability they analyse earnings on a US GAAP or IAS basis, as appropriate. The analysis is done by looking at the key financial ratios, these differ according to the type of insurer.

### *Market Profile*

This is influenced by the company's mix of business, the risk inherent in that business and the company's competitive position. AM Best places most importance on market profile for insurers writing long-term business. The key issues are:

**Revenue composition** – including revenue from investment income as well as from premiums. The book of business is looked at in terms of the spread of business to establish the risk, this depends on the geographic spread of the business as well as the lines written.

**Management experience and objectives** – this looks at the current and future operating performance and the management’s ability to develop and execute defensible strategic plans.

**Competitive position** – this analyses a company’s competitive advantage and its ability to respond to market challenges, economic volatility and regulatory change.

**Spread of risk** – this looks at a company’s geographic, product and distribution channel spread of business.

**Event risk** – this looks at the impact of sudden or unexpected events.

### *Moody’s rating methodology*

(Source: European Life Insurance – Rating Methodology June 2001 (Damien Regent) supplemented by information about rating methodology for US Property & Casualty insurers)

Moody’s assessments are forward-looking and done on an ongoing basis, they are not an assessment of past performance and solvency. There is a strong emphasis on qualitative measures since current financial performance is not always an accurate indicator of future performance and strength. This means that the judgement of the analyst is very important.

Their approach is structured but there is considerable flexibility to consider an individual company’s specific circumstances. There is a standard set of ratios that analysts can call on but the use of these is tailored for each rating.

The ratings focus on guaranteed benefits. The rating is not intended to give an opinion about future or past investment performance and bonuses. Ratings are only given for insurance companies, not groups.

There is a review process where a committee decides on the rating.

The analysis covers the following issues:

### *Company franchise*

**Franchise value** – This looks at the company’s competitive position, including its market presence, brand identity and various aspects of its operations. Part of the assessment is whether it has sustainable competitive advantages.

**Strategic focus and risk appetite** – The analyst conducts a full review of management’s attitude towards future strategies and the expectations for growth and profitability.

**Management and corporate governance** – This looks at the financial track record of management. It also considers the relevant experience of the board members and the motivations and track record of the major shareholders.

**Institutional support/ownership and organisational structure** – Moody’s does not allocate group ratings that can be applied to any part of a group company, since group support for each subsidiary cannot be guaranteed. However, it is recognised that the strength of a life insurer is affected by its relationship with its parent, subsidiaries or affiliates. The overall strength of a group is an important consideration in arriving at the rating of an insurer. The final rating reflects the level of support to the insurer from its shareholders

**Distribution and brand** – This looks at the degree to which the distribution and brand is a key competitive advantage.

### *Financial analysis*

**Profitability** – This is an assessment of the factors that affect profitability and draws a conclusion about the expected long-term profitability and the risk that actual results may deviate from the expectation. Due to the differences in profit-reporting across Europe Moody’s do not focus on one single measure of profitability.

**Investment risk and asset quality** – The asset quality is assessed by considering credit risk, interest rate risk and foreign exchange risk relative to the insurer’s liabilities. There is also consideration of the concentration of risk and the marketability of assets.

**Solvency and capitalisation** – This is one of the critical parts of the analysis and focuses on the free capital that is available to cover the obligations. Moody’s do not impose a capital adequacy model on insurers when compiling their ratings. For life insurers the capital available will include any funds set aside for future bonuses.

**Financial leverage** – The analysis looks at any intra-group lending and considers the impact this will have on financial strength. The analysis is done by looking at the resulting cashflows.

**Reinsurance** – This evaluates the use of reinsurance and the quality of the arrangements in place.

**Reinsurance and Liabilities, underwriting and reserves** – The analysis in this area varies between life and non-life insurers.

For life insurers Moody's scrutinise the strength of the actuarial assumptions and the liability structure of the insurer including any options and the degree to which they are consumer confidence or interest-rate sensitive.

This evaluates the premium rate monitoring and underwriting process. They also use a number of techniques to assess the strength of the reserves, these include reasonableness tests and actuarial projection models.

## Standard & Poor's capital adequacy models

### *Capital adequacy model for EU non-life insurer*

(Source: Enhanced Criteria To Evaluate European Insurers' Capital Adequacy, October 5, 1998, Rob Jones, London and European Capital Model)

Standard & Poor's focuses on capital adequacy in two ways: first at the level of capital needed by insurers to support their business needs at a given rating level, and second from a structural and quality of capital perspective. In many cases, analysis will go beyond the insurer being rated and will look at the entire group of which the rated insurer is a part, and will involve holding company analysis as well (where applicable). S&P have developed a sophisticated risk-based capital model which analyses these factors and develops a capital adequacy ratio. The model plays an important role influencing their view of an insurer's capital strength, but is only one tool in the rating process.

It is important to keep in mind that this capital adequacy ratio is a reference point for judging the adequacy of capital. In determining the capital adequacy, S&P will apply qualitative as well as quantitative factors to the insurance company's capital position. These qualitative factors will include assessment of the company's management and ownership.

The S&P capital adequacy model compares total adjusted capital minus potential investment losses and credit losses against a base level of surplus appropriate to support ongoing business activities.

#### Model formula

Total adjusted capital – investment risk charges (C1) – Other credit risk charges (C2)  
Underwriting risk (C3) + Reserve risk (C4) + Other business risk (C5)

#### Overview of calculation method of capital for risk categories

- For each risk capital (C1 to C5), the category is divided into risk components, for example, underwriting and reserve risk are analysed into the major classes of business.
- For each component an exposure proxy is assessed, for example, for underwriting risk this is taken as premiums written net of reinsurance, but gross of acquisition costs. The proxy may then be adjusted eg accounting variations.
- The adjusted proxy is then multiplied with the risk factor for that component to arrive at the risk charge per component.
- The sum of all the risk component charges equals the capital risk charge for the category.

Components of formula

The components of the formula can be further defined:

**Components of the formula**

<b>Total Adjusted Capital (TAC)</b>	Required capital for investment risk (C1)	Required capital for other credit risk (C2)
<ul style="list-style-type: none"> <li>■ Reported shareholders' funds</li> <li>■ Equity adjustments</li> <li>■ Asset value adjustments</li> <li>■ Non-life loss reserve adequacy adjustments</li> <li>■ Plus/(Minus) Other and analyst adjustment</li> </ul>	<ul style="list-style-type: none"> <li>■ Default risk</li> <li>■ Volatility risk</li> <li>■ Concentration risk</li> <li>■ Size factor adjustment</li> <li>■ Analyst adjustment</li> </ul>	<ul style="list-style-type: none"> <li>■ Reinsurance recoverable default risk</li> <li>■ Other assets</li> <li>■ Analyst adjustment</li> </ul>

**Required capital for non-life underwriting (net premium) risk (C3)** - This measures the extra capital required against the risk that actual cost of claims may vary from the expected cost implicit in the premiums currently being charged.

Premium charges are applied to premiums written net of reinsurance, but gross of acquisition costs.

### Premium Charges

Class of business (%)	Direct	Reinsurance	
		Proportional	Non- proportional and facultative
Health	12	12	18
Accident	18	18	27
Motor	12	12	18
Property*	19	19	30
Liability	27	27	29
Pecuniary	18	18	27
Credit	75	75	115
Finite	N.A.	N.A.	4
*For a reinsurer writing catastrophe business, the property catastrophe premium charge is replaced by the estimated impact on capital (including reinstatement premiums, but excluding tax recoveries) of a loss scenario representing a worst-case event (normally with a severity of at least a once in 100-year return period) relevant to the company/group.			
(Source: Enhanced Criteria to Evaluate European Insurers' Capital Adequacy, October 5 1998, Rob Jones, London)			

**Required capital for non-life reserve risk (C4)** - This measures the expected variability in reserve levels and the capital required to finance this. Adequacy of reserves is dealt with as a separate adjustment to Total Adjusted Capital.

Reserve charges are applied to the loss reserves net of reinsurance recoverable.

### Reserve Charges

Class of business (%)	Direct	Reinsurance	
		Proportional	Non-proportional and facultative
Health	5	5	5
Accident	28	28	28
Motor	12	12	12
Marine, aviation, etc	16	16	16
Property	22	22	28
Liability	10	10	10
Pecuniary	28	28	28
Credit	25	25	25
Finite	N.A.	N.A.	6
(Source: Enhanced Criteria to Evaluate European Insurers' Capital Adequacy, October 5 1998, Rob Jones, London)			

**Required capital for non-insurance risk (C5)** - E.g. 8% of risk weighted assets of banking operations

#### Gearing

The evaluation of capital adequacy also looks at how highly geared an insurer, or insurance group, may be. Key gearing benchmarks include financial leverage, reserve leverage, and investment leverage. Financial leverage (or gearing) looks at how much of an insurer's capital structure is supported by equity and how much by debt-type instruments. Ratios typically reviewed include:

- debt/capital (capital defined as debt plus equity);
- preference shares/capital;
- debt + preference shares/capital;
- fixed charge coverage (with and without preference shares dividends, as appropriate).

### *Capital adequacy model for British life assurers*

(Source: Risk-Based Capital Model for British Life Assurers July 2000 (Martin Lees, Carolyn Rajaratnam))

The capital model is only one of the areas analysed in assessing the financial strength. Analysts place at least as much emphasis on projected future capital adequacy as on the current adequacy ratio. Other factors taken into account include: financial flexibility, operating performance, business position, investments, management and strategy.

The model produces a Capital Adequacy Ratio which compares the available adjusted net assets to the amount of capital required to support the liabilities at a 'BBB' level of security.

The base model developed by S&P is quite complex but on grounds of practicality does not address all possible features and variations of UK life offices. Therefore the analyst plays a critical role in adjusting the base model for both quantitative and qualitative features unique to a particular company.

The model compares the Total Adjusted Capital (TAC) with the aggregate risk requirements for its portfolio of business. The types of risk covered are:

- Asset risk (including credit risk and volatility)

Credit risk charges are defined as the present value of expected losses from the portfolio and are calculated considering a period of several years. Volatility risk is considered over a 12 month period. Since the UK already imposes a resilience test on insurers the volatility risk of assets that are backing the mathematical reserves is lower than volatility risk for other assets.

- Pricing risk (including mortality, morbidity, persistency and expense risk)

Factors are applied to the gross premiums written during the year. Different factors are applied to different classes of business. Single premium contracts are generally regarded as less risky than regular premium contracts, though non-profit annuity contracts are considered high risk. Factors are also applied to the sums at risk to measure the extent of morbidity and mortality risk. A sliding scale is used reflecting the reduced risk in large portfolios.

- Reserving risk (including risks from guarantees and options)

Reserving risk is calculated by applying factors to the reserves held. It covers a range of reserving risks including expense, persistency, mortality/longevity, and reinvestment. There is also consideration of under-reserving risk on non-linked business and mis-pricing risk on linked business. This category is also used to account for risk from guarantees and options.

- General business risk (including regulatory risk)

Risks covered include mismanagement, fraud, ICS levies and tax changes. These risks are hard to quantify but S&P consider it reasonable to base the charge on gross premiums. This category also includes regulatory risk which is significant in the UK. The factors used for this risk vary according to distribution channel with IFA business being considered less risky.

For an overview of the calculation methodology of the risk components see non-life model above.

For non-profit business the asset risk is deducted from the TAC and the result is divided by the sum of the other three risks. However for with-profit business the full TAC is divided by the sum of all four risks. The rationale for this is that, in the UK, for with-profit business, the asset risk dominates the other three risks and therefore it is important to assess the extent to which the insurer can cover this risk.

Therefore the formula used for the capital adequacy ratio is:

$$\frac{\text{Total Adjusted Capital - asset risk for non-profit business}}{\text{asset risk for with-profit business + pricing risk + reserving risk + general business risk}}$$

S&P uses the company's financial statements as its starting point rather than the regulatory returns. This is because it frequently needs to calculate financial strength at a group level.

The Total Adjusted Capital is made up of a number of items:

- Shareholders' equity

This consists of paid-up share capital and retained earnings. If the company has any general insurance business then the claims equalisation reserves etc. can be added. However the solvency margin is deducted.

- Fund for future appropriations (FFA)

In the UK a life company must meet policyholders' reasonable expectations when distributing bonuses. The general market interpretation of this is that payouts should be linked to a policy's smoothed asset share. Therefore a reduction is made to allow for the smoothing of future appropriations. The shareholders proportion is then calculated, this is increased to include part of the orphan estate only if the insurer has gained their regulators agreement that it is attributable to shareholders. There is also a credit given of 50% of the next year's terminal bonus since in extreme circumstances this bonus could be waived half-way through the year.

Any explicit resilience reserve is deducted since it is normal practice to allow for resilience by calculating the reserves on a more conservative basis.

The fund for future appropriations is generally regarded as only being available to cover risks arising in the fund in which it resides.

- Future surpluses arising on in-force business

For non-profit business 50% of the future surpluses are allowed for since this is considered to be a prudent estimate of the amount that could be realised. This leaves the remaining 50% unaccounted for though the qualitative analysis might make allowance for this.

For with-profit business allowance is made only to the extent that the future surpluses are not allowed for in the FFA.

It is only the shareholders' part of future surpluses that is allowed for and therefore in a mutual office no credit is given.

It is recognised that different offices use different valuation assumptions and therefore adjustments may be made to reflect the varying strengths of valuation bases.

- Deferred acquisition costs (DAC)

Credit can be given for up to 50% of the DAC however only to the extent that this is not already allowed for in the future surpluses.

- Goodwill

There is usually no credit for goodwill. In exceptional circumstances (such as if the goodwill is in respect of a non-core business and is expected to be realised) a credit of up to 50% amortised over four years can be given.

- Reserve margins

Where embedded values are not calculated credit can be given for any use of a strong valuation basis which depresses the reported capital.

- Hybrid debt and reinsurance financing

Credit is given for any debt instruments with equity-like characteristics. However where the debt is serviced from future surpluses, or otherwise allowed for elsewhere, no credit is given. Reinsurance which has been used to boost the reported surplus is allowed for by reducing the TAC.

## **Proposed draft Basel Capital Accord accreditation criteria for rating agencies**

With the wider and more structured use of rating agencies, the Basel Committee has proposed a series of criteria which rating agencies would have to meet fully before their rating regime could be considered for use in the supervisory process. The criteria, all of which must be fulfilled, are as follows:

- **Objectivity:** The methodology for assigning credit assessments must be rigorous, systematic, and subject to some form of validation based on historical experience. Moreover, assessments must be subject to ongoing review and responsive to changes in financial condition. Before being recognised by supervisors, an assessment methodology for each market segment, including rigorous backtesting must have been established for at least one year and preferably three.
- **Independence:** An External Credit Assessment Institution (ECAI) should be independent and should not be subject to political or economic pressures that may influence the rating. The assessment process should be as free as possible from any constraints that could arise in situations where the composition of the board of directors of the shareholder structure of the assessment institution may be seen as creating a conflict of interest.
- **International access/Transparency:** The individual assessment should be available to both domestic and foreign institutions with legitimate interests and at equivalent terms. In addition, the general methodology used by the ECAI should be publicly available.
- **Disclosure:** An ECAI should disclose the following information: its assessment methodologies, including the definition of default, the time horizon and the meaning of each rating; the actual default rates experienced in each assessment category; and the transitions of the assessments, e.g. the likelihood of AAA ratings becoming AA over time.
- **Resources:** An ECAI should have sufficient resources to carry out high quality credit assessments. These resources should allow for substantial ongoing contact with senior and operational levels within the entities assessed in order to add value to the credit assessments. Such assessments should be based on methodologies combining qualitative and quantitative approaches.
- **Credibility:** To some extent, credibility is derived from the criteria above. In addition, the reliance on an ECAI's external credit assessment by independent parties (investors, insurers, trading partners) is evidence of the credibility of the assessments of an ECAI. The credibility of an ECAI is also underpinned by the existence of internal procedures to prevent the misuse of confidential information. In order to be eligible for recognition, any ECAI does not have to assess firms in more than one country.

## **Brief description of applications of solvency methodologies in the European Union, United States, Canada and Australia**

### *European Union - Fixed ratio approach*

Every insurance company authorised to carry on business in the EU must maintain a margin of solvency. This requirement does not currently apply to pure reinsurance companies in Member States where such companies are not subject to prudential supervision.

The margin of solvency of a company is the excess of its admissible assets over its liabilities. The value and amount of assets and liabilities must be determined in accordance with prescribed rules (the rules for valuation of assets and liabilities for regulatory purposes vary between Member States and are considered in more detail in chapters 4 and 5 of this study. Furthermore there are specific rules in the EU Directives with respect to the extent to which liabilities in relation to cumulative preference shares and subordinated loan capital may be added back for the purposes of determining net assets for solvency purposes. Member States can also permit life companies to take account of 'implicit items' ie future profits, zillmerising (allowance for initial costs in the net premium liability valuation method) and hidden reserves to a specified extent.

The margin of solvency should not fall below a minimum amount, the calculation of which is set out in the Article 16 of the EU First Non-Life Directive and Article 19 of the EU First Life Directive for non-life and life business respectively. In practice, Member States may expect the actual margin of solvency to be significantly in excess of the solvency margin requirement.

Non-life calculation of solvency margin requirement

The solvency margin requirement for non life companies is calculated as the higher of the following three figures:

Premiums Basis

- 18% of first 10 million Euro of gross written premiums for the year;
- 16% of remainder of gross written premiums for the year.

Claims Basis

- 26% of first 7 million Euros of average claims incurred over last 3/7 years (the seven year reference period applies where the undertaking underwrites only one or more of the risks of credit, storm, hail or frost);
- 23% of remainder of average claims incurred over the last 3/7 years.

All of these percentages are reduced to a third of these amounts in the case of health insurance practised on a similar basis to life assurance subject to certain conditions being satisfied.

For both the premiums basis and the claims basis, the results obtained are reduced by multiplying by a factor which is the ratio of claims incurred net of reinsurance to claims incurred gross of reinsurance. The reduction for the effect of reinsurance recoveries is restricted to 50%.

### Minimum guarantee fund

This figure is laid down in Article 17(2)(a) of the First Non life Directive and varies between 200,000 and 1,400,000 Euro depending on the classes of business underwritten.

In practice the minimum guarantee fund is unlikely to be applicable for most companies as the premiums or claims basis will give rise to higher figure. The premiums basis is likely to give rise to a higher requirement in cases where a company's business is expanding and the claims basis is likely to give rise to a higher requirement where the level of business is declining.

### Life calculation of solvency margin requirement

The RMM for life companies is calculated as the higher of the following two figures:

#### Required solvency margin

By contrast to the non life calculation above, the required solvency margin for long term business is based not on premiums and benefits paid, but on the 'mathematical provisions' (life business liabilities) and on 'capital at risk' which is the amount payable on death less the mathematical provisions.

The required margin of solvency is the aggregate of two calculations:

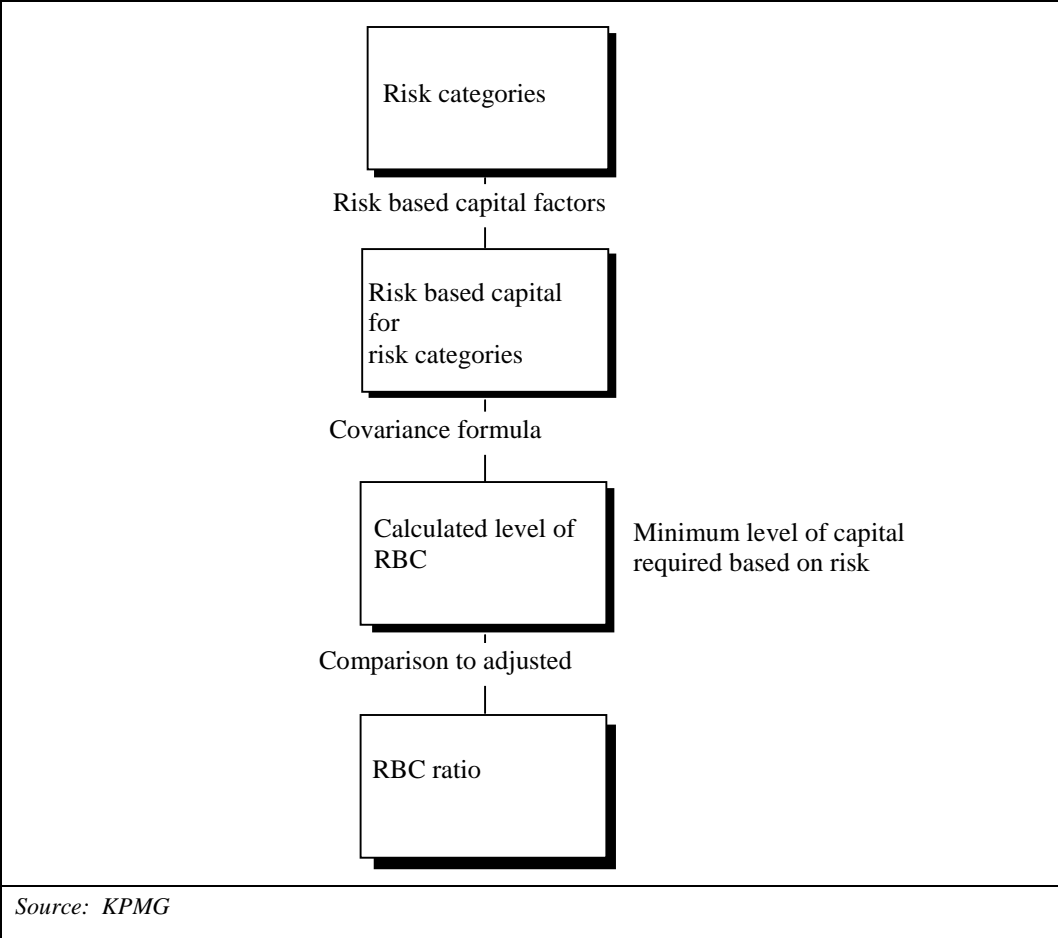
- the first calculation is 4% (0% to 1% for certain business) of the mathematical provisions gross of reinsurance, reduced to allow for reinsurance recoveries (subject to 15% maximum reduction);
- the second calculation is generally 0.3% of the gross capital at risk (generally capital at risk less the mathematical provisions) reduced to allow for reinsurance recoveries (subject to a maximum reduction of 50%).

### Minimum guarantee fund

- For life business the minimum guarantee fund is normally 800,000 Euro. This figure is reduced by 25% for mutual companies.
- In practice the minimum guarantee fund is unlikely to be applicable for most companies as the required margin of solvency will give rise to a higher figure.

**United States**

*RBC model overview*



*Implementation in the US*

Prior to the adoption of the RBC model, quantitative analysis was generally performed using IRIS ratios. The ratios became less useful as some troubled insurers grouped balance sheet accounts in specific ways to circumvent the purpose of the ratios. In the late 1980's and early 1990's the number of insolvencies increased for several reasons. The US regulators decided to review their quantitative processes and seek improvements to better predict troubled insurers and to require supervisors and companies to take specific action once a company triggered a certain level. The RBC model for life insurers was implemented by the NAIC for 1993 year ends; the property-casualty model was implemented in 1994. Each State legislative body generally adopted the models for use in their state shortly thereafter.

### *RBC model for life insurers*

#### Overview

The RBC model for life insurers is structured around the concept of asset risk. In the RBC model, industry risk factors are applied to each of four risk categories. The total capital for each risk category is then combined according to a formula to determine the required level of capital for an insurer.

#### Risk categories

The four risk categories:

- asset risk;
- insurance risk;
- interest rate risk; and
- business risk.

**Asset risk** is the risk of loss on investments arising from default on interest and principal payments or from a decline in market values. It determines the capital required to support all risks of investment management.

Different RBC factors are applied to each type of investment, depending on the level of inherent risk. The factors range from 0-1% for government bonds to a maximum 30% for bonds and mortgages in default. These factors are applied to the balance sheet value, and aggregated to produce the total capital required to cover asset risk.

The different asset types are:

- investment-grade bonds;
- less than investment-grade bonds;
- mortgages - current;
- mortgages - delinquent;
- common stock - affiliated;
- common stock - unaffiliated;
- real estate;
- reinsurance (excluding affiliates); and
- off balance-sheet items.

An asset concentration factor is added to the asset risk total. This factor is designed to reflect the risk involved in high concentrations of assets with one issuer or borrower. The effect of this factor is basically to double the risk based capital of the ten largest exposures. Certain types of assets are exempt from this adjustment, such as assets with an RBC factor of less than 1%, affiliated common stock and assets already at the maximum factor of 30%.

**Insurance risk** is the risk that premiums will not be sufficient to cover unfavourable changes in mortality, morbidity and expenses. Normal variations in experience are expected to be covered by premiums, expense loadings, conservative reserve valuation assumptions and reinsurance. This calculation determines the capital required for adverse insurance experience, due to inadequate pricing as well as random fluctuations in claims levels.

The RBC factors vary from 7% to 35% of premiums for permanent health insurance and 0.06%-0.15% of the capital at risk for life insurance, scaled by size.

**Interest rate risk** is the risk that unexpected cash outflows or inflows may occur during periods of rising or falling interest rates.

When interest rates rise, policyholders may withdraw their funds and invest elsewhere, if the surrender penalties are not too prohibitive. The insurer may have to liquidate a portion of its bond portfolio at a loss. Conversely, when interest rates fall, policyholders may try to add money to their single or flexible premium policies before the insurer has an opportunity to lower its credited interest rate. In this situation, the insurer may not be able to invest the funds received at a rate which is greater than the contracted rate.

The RBC interest rate factors range from 0.75-3% of annual statement provisions, depending on the nature of products written.

**Business risk** calculates the capital required for miscellaneous risks and events not captured in the above categories. Examples of business risks include guarantee fund assessments, changes in tax laws, fraud and contingent liabilities.

A percentage of guarantee fund assessments received by the company is used to approximate all business risks. The RBC charge is set at 2% and 3% of life and annuity and of health premiums respectively.

RBC calculation

The RBC rate formula is as follows:

$$\text{RBC ratio} = \frac{\text{adjusted capital}}{\text{calculated capital}}$$

Calculated capital is determined based on the RBC factors applied to each category of risk, as discussed above.

Each formula recognises the correlation between various types of risk. The formulae apply a covariance calculation to determine the appropriate risk based capital. The levels of regulatory action are determined from the risk based capital after covariance. This adjustment reflects the fact that the cumulative risk of several independent, not correlated, items is less than the sum of

the individual risks. The covariance adjustment follows the steps of adding together items that are believed to be correlated, so that what is left are groups of risk items believed to be substantially not correlated to each other. The covariance adjustment then squares these resulting groups, adds the resulting squares together and takes the square root of the sum of the squares. The covariance adjustment drastically reduces the importance of the smaller items and the dominance of the biggest items affected by the adjustment.

The covariance adjustment reduces the aggregate amount of risk based capital in recognition of the fact that the risk is remote and that surplus will be simultaneously impaired by reductions in the value of the assets and increases in the value of liabilities. In the covariance adjustment, the greater the number of slices that the total risk based capital is carved into (asset risk, underwriting risk, etc.), the greater the discount afforded by the covariance adjustment. As a rule of thumb, the greater the number of component pieces, the greater the effect of the covariance adjustment. Therefore, even if the formulae use the same risk factors for the same types of assets and liabilities, the results of the covariance adjustment can produce a difference in the final risk based capital requirement for each insurance type.

The model assumes that asset and interest rate risk are correlated, whilst insurance risk is independent. The formula is as follows:

#### **Covariance formula**

$$\text{Calculated level of capital} = (\text{square root} [(C1 + C3)^2 + C2^2] + C4) / 2$$

where:

- C1 = asset risk RBC
- C2 = insurance risk RBC
- C3 = interest rate risk RBC
- C4 = business risk RBC

Adjusted surplus is defined as capital and surplus as reported in the annual accounts, plus 50% of the dividend liability on with profits liabilities. The dividend liability is assumed to provide a general reserve for adverse future experience.

The level of the RBC ratio determines the need for regulatory intervention.

RBC life model example

The following is an example of an RBC calculation for ABC Life Insurance Company. The RBC for each risk category has been calculated, then used in the covariance formula to produce an RBC ratio.

**C1 - Asset risk**

	Annual statement value (A)	RBC factor (B)	RBC amount (A) * (B)	Notes
Bonds - government	50,000,000	0.0030	150,000	
Bonds - other	2,000,000	0.0100	20,000	
Size factor for bonds			150,000	(1)
Mortgage loans - current	15,000,000	0.0300	450,000	(2)
Common stock	3,000,000	0.03000	900,000	
Real estate	3,000,000	0.1000	300,000	
Asset concentration factor			650,000	(3)
Total asset risk			2,620,000	
(1)	The size factor is designed to reflect the increase in risk as the number of bond issuers decreases. Each tranche of 50 issuers is assigned a risk weighting, which produces a weighted number of issuers. The size factor is applied to the RBC for bonds.			
(2)	The RBC for mortgages includes a mortgage experience adjustment, calculated as the ratio of the company's delinquency experience relative to industry experience for the prior two years.			
(3)	This adjustment doubles the RBC factor for the ten largest holdings, to a maximum of 30%. Certain assets are excluded.			

Insurance risk is determined as follows:

**C2 - Insurance risk**

	Annual statement value (A)	RBC factor (B)	RBC amount (A) * (B)	Notes
Ordinary life insurance in force	600,000,000			
Life insurance provisions	75,000,000			
Total net amount at risk	525,000,000		775,000	(1)
Net amount at risk				
First 500 million	500,000,000	0.0015	750,000	
Next 4,500 million	25,000,000	0.0010	25,000	
	525,000,000		775,000	
(1)	The factors for life insurance increase as in-force business decreases, reflecting the decrease in risk for larger blocks of insurance.			

Interest rate risk is determined as follows:

### C3 – Interest rate risk

	Annual statement value (A)	RBC factor (B)	RBC amount (A) * (B)	Notes
Ordinary life insurance provisions	75,000,000	0.0075	562,500	
Annuity provisions with surrender change	1,000,000	0.0150	15,000	(1)
Total			577,500	
Notes				
(1) Policies with surrender charges have a higher risk factor than policies that are not cancellable.				

Business risk is determined as follows:

### C4 - Business risk

	Annual statement value (A)	RBC factor (B)	RBC amount (A) * (B)	Notes
Life and annuity premiums	5,000,000	0.0200	100,000	

The risk based capital is calculated as follows:

### Calculation of RBC

	RBC amount	Notes
Total C1	2,620,000	
Total C2	775,000	
Total C3	577,500	
Total C4	100,000	
	<hr/>	
Total of risks	4,072,500	
Effect of covariance	(682,420)	(1)
RBC	3,390,080	(1)
Minimum RBC	1,695,040	(2)
Adjusted capital	4,500,000	
<i>RBC ratio</i>	265.5%	
(1) Included for illustrative purposes only. These figures have been calculated based on the minimum RBC figure.		
(2) Minimum RBC has been calculated using the formula presented above.		

### RBC model for property-casualty (non life)

#### Overview and objectives

The RBC model for property-casualty (P-C) insurers is similar in concept to the life model, except that it emphasises underwriting risk. In addition, the risk factors used are based on the company's own experience, rather than using industry-wide factors.

#### Categories of risk

The P-C RBC model takes into account four types of risks:

- asset risk;
- credit risk;
- loss reserve risk; and
- written premium risk.

A factor is assigned to each component of the risk categories to determine the risk capital.

**Asset risk** is the risk of loss on investments arising from default on interest and principal payments or from a decline in market values. It calculates the capital required to support all risks of investment management, including liquidity risk, price risk, reinvestment risk and asset-liability mismatch risk.

Factors similar to those used in the life model are assigned to the various types of assets.

**Credit risk** is designed to account for the risk of default by reinsurers and agents. A 10% charge is applied to all recoverables, except affiliated US reinsurers.

The **loss reserve risk** determines the capital required to support the risk of adverse development in excess of expected investment income. It is calculated using industry-wide experience by line of business, adjusted according to the insurer's reserve experience.

The loss reserve risk includes a reserve concentration adjustment and a reserve growth adjustment. The reserve concentration adjustment gives credit to multi-line insurers whose lines of business represent independent risk factors. For example, automobile and liability insurance experience are dependent on quite different risk factors. The reserve growth adjustment is a surcharge of up to 45% levied against companies whose premium growth exceeds 10% over a three year period.

**Written premium risk** determines the capital required to support the risk of inadequate premium pricing. It also includes a premium concentration adjustment and a premium growth adjustment. As with the loss reserve risks, additional charges are assigned to insurers whose premiums are concentrated in a few lines of business or who have experienced high premium growth.

### Calculation of RBC

The RBC model for P-C insurers, uses the same RBC ratio formula as for life insurers as illustrated below:

$$\text{RBC ratio} = \frac{\text{adjusted capital}}{\text{calculated capital}}$$

Calculated capital is determined based on the RBC factors applied to each category of risk, as discussed above. Early RBC models calculated the required level of capital by adding all of the above risk factors. This produced a 'doomsday' effect by assuming that all adverse risks occur at once.

Each risk category is now combined according to a formula which, as with the life model, considers the covariance amongst the various categories. In effect, the formula takes into account the fact that adverse conditions are not likely to affect all risk categories simultaneously.

### *Supervision using RBC models*

The RBC ratio, which compares the adjusted level of capital and surplus to the calculated capital amount, determines whether supervisory action is required.

Supervisory intervention is required at the following RBC ratio levels:

- *company action level* (RBC ratio 150-200%) - the insurer must file a comprehensive financial and business plan.
- *regulatory action level* (RBC ratio 100-150%) - in addition to the above, the regulator must examine and require corrective action of an insurer.
- *authorised control level* (RBC ratio 70-100%) - in addition to the above, the regulator may take control of an insurer.
- *mandatory control level* (RBC ratio less than 70%) - the regulator is required to place the insurer under regulatory control unless it is reasonable to believe the situation will correct itself within 90 days.

The above actions are applicable to both life and P-C insurers.

## **Canada**

### Fixed ratio approach

#### Non - life

The Canadian non-life model is similar to the EU model in requiring insurers to maintain a margin of admissible assets in excess of adjusted liabilities. The Canadian regulator expects a margin of admitted assets over adjusted liabilities of at least 10%.

Admissible assets are total assets, adjusted for the difference between market value and book value of investments, and deducting non-admitted assets, notably deferred policy acquisition costs.

Liabilities are also adjusted for the purposes of the test, primarily by adding margins as described below:

Accident and Sickness policies

Margin consists of:

- 15% of net unpaid claims and adjustment expenses; plus
- 15% of net unearned premiums.

Policies other than Accident and Sickness

The margin is the higher of the following three:

- unpaid claims and unearned premiums;
- premiums written;
- claims incurred.

*Unpaid claims and Unearned Premiums basis*

- 15% of unpaid claims; plus
- 15% of unearned premiums – with some adjustment for reinsurance.

*Premiums written*

- 15% of gross premiums written during preceding 12 months;
- there is a supplementary margin on gross premiums (the lesser of 5% of gross premiums written and \$500,000).

*Claims incurred*

- 22% of average annual gross claims incurred during preceding 36 months;
- there is a supplementary margin (lesser of 7% of average annual gross claims incurred during preceding 36 months and \$500,000)

Effective 2003, this minimum asset test will be replaced by a risk based capital requirement broadly similar to the life MCCR model described below.

Life

For life companies the MCCR (Minimum continuing capital and surplus requirements) is used.

*Minimum Continuing Capital and Surplus Requirements (MCCSR )*

This is the mechanism for measuring the relative strength of domestic life insurers. It is referred to as Test of Adequacy of Assets in Canada and Margin Requirements (TAAM) for Canadian branches of foreign life insurers. In essence the application is as follows:

$$\text{MCCSR Ratio} = \frac{\text{Available Capital}}{\text{Required Capital}} \times 100$$

The regulator requires an overall margin well above a 100% ratio, which has been escalating in recent years, and pays very close attention to companies below 150%.

*TAAM*

For TAAM, the available capital is replaced by “Excess of Assets in Canada” determination i.e. net assets available less net assets required in Canada.

The test of adequacy ratio is similar to MCCSR ratio:

$$\text{TAAM} = \frac{[1 + \text{Excess of Assets in Can.}] \times 100}{\text{Required Capital}}$$

*Available Capital*

The available capital is split into two elements, namely:

- Tier 1 - Core Capital;
- Tier 2 - Supplementary Capital.

*Tier 1: Core Capital (free surplus)*

This comprises mainly the following:

- common shareholders equity, defined to include common shares and related contributed surplus, as well as unappropriated earned surplus;
- qualifying non-cumulative perpetual preferred shares;
- participating account;
- non-participating account (mutual companies);
- currency translation account;
- qualifying non-controlling interests in subsidiaries arising on consolidation from tier 1 capital instruments;
- adjusted net deferred gains/losses on investments that have not been taken into account in the valuation of policy liabilities.

Deductions in calculating Tier 1 capital are made for the following:

- goodwill;
- CSV (Cash Surrender Value) deficiencies calculated on an aggregate basis;
- negative provisions calculated policy by policy;
- adjusted unrealized amortized net gains/losses on stocks and real estate;
- adjusted net deferred gains/losses on stocks and mutual funds backing liabilities x 50%;
- adjusted net deferred gains/losses on real estate backing liabilities x 50%..

Tier 2: Supplementary Capital

Tier 2 can be further sub-divided into:

- Tier 2A: hybrid (debt/equity) capital instruments such as cumulative preferred shares, subordinated debt;
- Tier 2B: limited life instruments such as limited life redeemable preferred shares, qualifying capital instruments issued in conjunction with a repackaging arrangement limited to 50% of Net Tier 1 capital;
- Tier 2C: other capital items such as 58% of current surrender value deficiencies on an aggregate basis, 58% of negative provisions on a policy-by-policy basis, limitations on negative provisions limited to 18% of Net Tier 1 Capital, “Net” unrealized unamortized net gains and losses on traded stocks split by taxes payable/nonpayable, “Net” = 50% x Total - 55% x 50% x amount backing liabilities and 50% of Out-of-Canada Terminal Dividends.

### *Required Capital*

The asset default risk factors are:

- asset default risk (C-1);
- off-balance sheet exposures;
- mortality/morbidity/lapse risk;
- interest pricing risk;
- changes in interest environment (C-3);
- segregated funds risk.

We understand that unlike the United States, there is no covariance formula which takes into account the risk interactions.

A brief explanation of the above risk factors is given below:

- asset default risk (risk of loss resulting from on-balance sheet asset default and from contingencies in respect of off-balance sheet exposure and related loss of income; and the loss of market value of equities and related reduction of income);
- off-balance sheet risk (risk of default of a counterparty on an off-balance sheet exposure);
- mortality / morbidity / lapse risks (risks that assumptions about mortality, morbidity and lapse will be different than expected);
- interest margin pricing risk (risk of interest margin losses with respect to investment and pricing decisions on in-force business other than asset default and changes in interest rate environment);
- changes in interest rate environment (risk of loss resulting from changes in the interest rate environment other than asset default and interest margin pricing risks);
- segregated funds risk (risk of loss arising from guarantees embedded in segregated funds).

OSFI (the Canadian regulatory body) and the CIA (Canadian Institute of Actuaries) are pushing for a stochastic modelling approach to determining the reserve and capital requirements in the future as opposed to the current (interim) factor driven approach.

Australia

Non-life

The Australian prudential supervisor (APRA) has introduced new Prudential Standards for determining the Capital Adequacy requirements for non-life insurance companies.

Under the new regulatory requirements the Minimum Capital Requirement (MCR) will be calculated using either:

- Internal model bases; or
- Prescribed bases

The MCR is subject to a minimum of A\$5 million.

A combination of both methods described below could be used depending on the mix of business of the company, and the relative sophistication of the company's internal models. The companies are provided with a choice of which method to use.

*Internal model based method*

Insurance companies will be encouraged to develop internal methods that reflect their own risk profile and nature of business. In any case the models should include most of the risks faced by the insurance company even when these risks are difficult to measure or model statistically. These models would be subject to regulators approval. This method is in line with stage 3 of Pillar I of the new draft Basel accord.

*The prescribed method*

For companies that are unable/unwilling to develop internal models the MCR is determined by prescribed formulae in the Prudential Standards. The MCR will be the sum of the charges for insurance risk (outstanding claims risk and premium liability risk), investment risk (value of assets risk and off-balance sheet risk, including market risk and credit risk), and concentration risk which takes into account the exposure to a single event (maximum event retention is used as a measure of the concentration risk). This method is equivalent to a stage 2 of Pillar I of the new draft Basel accord.

## Life

A two-tier approach to capital requirements is used for life companies:

- First – a solvency standard to test that a life company would meet current obligations in a run-off situation. This is done by considering the various risks which would impact the security of the policy owners' entitlements, and requiring the provision of a prudent level of reserve against such risks. The solvency margin requirement broadly comprises the following components: (a) the solvency liability; (b) other liabilities; (c) the expense reserve; (d) the resilience reserve (e); the inadmissible assets reserve.
- Second – a capital adequacy test that the life office has enough capital to meet the solvency requirement, but also that it has enough capital to fund its future business plan and conduct its business in an unfettered manner. This is done by considering the various risks which would impact the longer term security of the policy owners' entitlements, and requiring the provision of a prudent level of reserve against such risks. The capital adequacy requirement broadly comprises the following components: (a) the capital adequacy liability; (b) other liabilities; (c) the resilience reserve; (d) the inadmissible assets reserve; (e) the new business reserve.

A brief explanation of the components is given below:

- solvency liability – a calculation of the value of the guaranteed liabilities under the policies on the basis of assumptions which are more conservative than best estimate assumptions. The conservative assumptions are largely prescribed by the Life Insurance Actuarial Standards Board (LIASB). The liability is set subject to a minimum of the Minimum Termination Value (surrender value) contractually payable on policies + outstanding claims + IBNR etc, by major product group. The liability + resilience reserve for a whole fund is subject to a minimum Current Termination Values (surrender value including current terminal bonuses etc without applying discretionary reductions) + outstanding claims + IBNR etc.

- capital adequacy liability – a calculation of the value of the liabilities under the policies on the basis of assumptions which are more conservative than best estimate assumptions. The conservative assumptions are based on an “appointed actuary” determined basis (best estimate + margin). The liability is set subject to a minimum of the Current Termination Value (as above) + outstanding claims + IBNR etc by major product group.
- other liabilities – the value of the liabilities of the statutory fund to other creditors, but excluding subordinate debt arrangements.
- resilience reserve – mismatching of asset and liability exposures necessitates the provision of a reserve for adverse movements in the investment markets to the extent that they will not be matched by a corresponding movement in the liabilities.
- inadmissible assets reserve – a reserve against the risks associated with (a) holdings in associated financial entities; (b) concentrated asset exposures.
- new business reserve – provision for planned new business over a prescribed new future period of three years, with the intention of securing continued solvency of the fund over that period.
- expense reserve – provision for the overrun of acquisition expenses which can occur upon closing a statutory fund to new business, and are not anticipated in the solvency liability determination.

### Use of Models

#### EU - UK Resilience Tests

The UK resilience test is a static scenario approach used by insurance regulators. Life insurance companies in the UK are required by regulators to assess the impact of changes in interest rates and asset values, under different scenarios in order to estimate the extra provisions required to meet their liabilities, should investment conditions change. These tests are known as resilience tests and are run at periodic intervals.

#### US - New York 7

The scenario test, required by the New York regulatory authorities, is a more advanced dynamic test compared to the UK resilience test. Life insurance companies that operate in the State of New York are required by supervisors to carry out scenario tests to assess the financial impact of possible changes in interest rates for different assets. Regulators have established seven different scenarios that combine changes of interest rates for different types of assets and investments.

Under the assumptions of each scenario the present position of assets and liabilities are projected to establish any available surplus or deficit for the next 20 or 30 years.

The surplus position at the end of 20 or 30 years is used as a benchmark value to determine the company's solvency. The appointed actuary should decide which actions to take should the company fail some of the scenarios. Typically failing one or two scenarios, particularly the most severe ones, would not require any intervention. Failing more than two scenarios may require some adjustments in investment plans.

The scenarios are fixed by regulators, some adjustments can be made in order to adjust the test to the company's profile and mixture of business. The result is the financial impact of interest rate changes but the likelihood of such events is not considered. The final decision is subjective and relies on the appointed actuary's expertise and judgement. The amendments that should be done as a result of the application of this scenario test will affect the basis of the RBC calculations.

## **Detailed analysis of the comparison of the different approaches to solvency methodologies.**

This Appendix provides a more detailed analysis of the comparison of the different approaches to solvency methodologies based on the criteria set out in section 10.5. In making our comparison, we have grouped fixed-ratio and RBC principles and likewise have grouped scenario-based and probabilistic approaches.

### *Capital definition and objective*

This section examines whether the approaches possess a clear underlying capital definition and objective.

#### *Fixed ratio / RBC*

The EU methodology and the US RBC approach lack a clear underlying capital definition and, therefore, an explicit link to the supervisory objectives.

Various attempts have been made to define RBC schemes in accordance with an explicit capital definition. The capital definition used by Lloyd's of London, and, initially, the non life US RBC was based on ruin probability approaches (similar to the Value at Risk concept); the required capital is set at a level that reduces the probability of insolvency to a prescribed percentage. However, this definition is not maintained when the total solvency requirement is calculated, because the interaction (dependence or independence) of the individual risks is not properly recognised in the aggregation of sub-results.

The lack of a capital definition means that the only criteria which can be used for judging the appropriateness of capital requirements lie in empirical studies of their historical (or as-if) performance<sup>10</sup>. The determination and discussion of specific aspects of these approaches, such as factor levels, is therefore greatly restricted.

The weaknesses arising from the lack of a capital definition cannot be overcome by amending existing requirements.

#### *Scenario based / Probabilistic approaches*

The use of scenario based approaches provides results with a clear and explicit meaning. In this methodology, the capital definition is the amount of capital needed to survive the considered scenarios. The effectiveness of this methodology depends crucially on the design of the scenarios used; all important risks need to be captured in the specific implementation of this methodology.

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<sup>10</sup> A particular calculation scheme can be said to be effective if a high percentage of insolvent companies have failed (actually or as-if) to meet the requirements and if a high percentage of solvent companies have met the requirements.

Probabilistic approaches explicitly relate capital requirements to the risks considered, the time frame examined and to the likelihood of failure. As with scenario based approaches, this enables an explicit definition of the objective (e.g. the capital definition may be the toleration of a specific ruin probability, or policyholder deficit level). The validity of a specific implementation can therefore be assessed against this defined objective. Thus, because it is clear what the approach is trying to achieve (unlike the fixed ratio methodology), a meaningful discussion of different parameters is possible.

### *Extent of risks recognised*

#### *Fixed ratio / RBC*

The narrow scope of risks considered is a major criticism of the fixed ratio approach<sup>11</sup> compared with other methodologies. Fixed ratios create the greatest difficulty in extending the scope of risk, because of the structural weaknesses of the approach. It is therefore the least flexible methodology from this perspective.

For RBC, the incorporation of a specific risk is possible in principle, by introducing new factors and exposure proxies. The validity of incorporating a greater number of risks is nevertheless impaired by general structural weaknesses in the approach, and in particular the difficulties related to risk interaction.

The US RBC approach aims for incorporation of all relevant risks. This is mainly achieved by having a crude category for general business risk (i.e. risks that cannot otherwise be specified, such as third party exposure, systems failures and so on). The requirement for this risk is calculated by applying a factor to premium volumes. This is a crude approach but there are no other methods currently in place which are superior. It is debatable whether it does provide an adequate buffer for companies against operational and general business risk. It does not provide an indicator with any predictive power, and it can be considered to penalise companies which minimise their business risk with good general and risk management.

#### *Scenario based / Probabilistic approaches*

Scenario based and probabilistic approaches commonly aim for inclusion of different sorts of risk within the methodology (e.g. more than simply underwriting risk) and therefore offer greater flexibility. The focus in most implementations, however, is on financial risks (i.e. underwriting risk, investment risk etc.) and problems with risks that are difficult to quantify are not easily overcome.

The problem of reliable experience data is evident for advanced versions of scenario based and probabilistic approaches. In particular, the development, estimation and calibration of reliable models of the probabilistic behaviour of the risks and their interaction imposes the need for significant quantities of data.

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<sup>11</sup> See the Müller Group Report (1997).

The reliability of the sub-models of individual risks may vary too much across the range of different risks. The results from the model might, therefore, be driven by subjective assumptions on the interaction of risks and sub-models, or by the weakest sub-model used.

In order to minimise the impact of these drawbacks a thorough sensitivity analysis (examining variations in assumptions and parameters) needs to be carried out, and this might lead to significant increases in cost and process complexity.

### *All approaches*

The problems associated with quantifying certain types of risks apply to all approaches, mainly due to a lack of experience and exposure data.

### ***Risk interaction***

#### *Fixed ratio / RBC*

The Müller report states that insolvencies are often due to the simultaneous strike of multiple risks and that some important risks (e.g. asset and long term risks) are omitted in the current EU approach. The consideration of risk in fixed ratio approaches is not sophisticated enough for a meaningful analysis of the different types of risk against which protection is needed. In addition, it is generally difficult to account for risk interaction within fixed ratio or risk factor based approaches. It would therefore be difficult to extend the EU approach to incorporate a wider range of risks.

The US RBC approach attempts to take the interaction of the risk categories into account by making explicit correlation assumptions and using the covariance formula. Nevertheless, there are limitations imposed by the fact that interaction has to be accounted for after the risk weighted results for the individual risk categories have been calculated<sup>12</sup>. Apart from this structural weakness, the specific correlation assumption for general business risk (which is assumed to be completely correlated with all other risks) is inadequate.

As a consequence fixed ratio and RBC approaches present problems for the recognition of diversification and business volume-effects and for the support of a clear underlying capital definition.

#### *Scenario based / Probabilistic approaches*

Scenario based approaches model the interaction of risks explicitly since the impact of various risks can be accommodated by appropriate scenario definitions. However, the combination of

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<sup>12</sup> Possible aggregations of sub results are *summation* (this assumes that all the risks are completely dependent and will strike at the same time) or *taking the maximum* (this assumes that the risks are mutually exclusive, i.e. they never strike at the same time [like exclusive scenarios]) or the *covariance formula* (assuming either complete dependence or independence of the categories). All of the above aggregations of the individual results are only giving crude consideration of the possible interactions.

various impact sizes from different risks has its limitations because it gives rise to the need for a large number of scenarios in order to take all possible relevant combinations into account.

Probabilistic approaches model the stochastic independence and dependence of the various risks in a flexible and sophisticated manner. Probabilistic simulation techniques enable the automated creation of scenarios that combine many combinations of individual risk drivers. This is more beneficial than the scenario based approaches, in so far as the scope of adverse scenarios is greatly widened. The validity of the final result will greatly depend on the validity of the probability distributions that govern the risk drivers and their interaction.

### ***Recognition of risk profiles***

#### *Fixed ratio / RBC*

The fixed ratio approach provides almost no recognition of company-specific risk profiles. Accordingly, the fixed ratio approach can be expected to result in inappropriate requirements for many companies because little account is taken of the company's exposure.

The US RBC approach is based on risk weighted sub-results and is therefore sensitive to the company-specific line of business and asset composition. Increasing the number of factors taken into account does increase the sensitivity of the approach to company-specific risk profiles. However, the model is not able to cope with risk interaction which reduces the value of the results.

#### *Scenario based / Probabilistic approaches*

Scenario based approaches provide flexibility in the recognition of company-specific risk profiles. The recognition of diversification effects arising from the volume of business written might require the evaluation of scenarios and modelling of their impact. The relevance and likelihood of one and the same scenario is likely to vary from company to company.

Probabilistic approaches provide good flexibility for refined risk sensitivity and for modelling risk interaction and size effects. The advantage produced by refining sub-categories is not off-set by weak interaction modelling.

Advanced risk-modelling approaches can take many aspects of risk into account that cannot be captured by fixed ratio or RBC approaches. These include:

- explicit consideration of impact;
- consideration of timing;
- explicit consideration of reinsurance and hedging;
- projection of future exposure and premium;
- consideration of trends;
- explicit consideration of risk interaction;

- improved consideration of diversification and size effects (for probabilistic approaches);
- explicit consideration of likelihood (for probabilistic approaches).

### ***Recognition of dynamic aspects***

#### *Fixed ratio / RBC*

The EU and US RBC approaches do not explicitly consider timing aspects for example the recognition of long-term risk, cash flow aspects, future growth expectations etc.

Some consideration of dynamic aspects might be incorporated implicitly in the factor calibration. However the result is likely to be crude and inflexible. Both the EU and the US RBC approach are essentially static.

#### *Scenario based / Probabilistic approaches*

Advanced scenario based and probabilistic approaches are typically dynamic. Information and consideration about the time aspects of risk can be incorporated, such as cash flows, loss development patterns, future growth projections etc.

### ***Recognition of hedges and reinsurance***

#### *Fixed ratio / RBC*

Both the fixed ratio and the US RBC approach can show poor recognition of the effects of reinsurance and hedges.

The effect of these instruments is approximated by using net reinsurance data figures or applying gross to net ratios within the calculation. This backward-looking approach does not, for example, capture changes to reinsurance programmes and, because of the limited time frame considered, is unlikely to give credit to protections against low frequency and high severity incidents (such as catastrophe reinsurance).

#### *Scenario based / Probabilistic approaches*

Fixed ratio and RBC approaches calculate requirements directly from exposure figures whereas advanced approaches apply explicit impact modelling, for example, for reinsurance risk. This allows for improved consideration of the effect of hedges or reinsurance arrangements. In the case of complex derivatives, ART or financial reinsurance arrangements the required modelling might however become complex and costly.

The adequacy of reinsurance arrangements and credit risk of the reinsurance programme are commonly not taken into account in the modelling.

***Predictive power****Fixed ratio / RBC*

Empirical studies have been undertaken to test the predictive power of various solvency methodologies. The Müller report concluded that the current EU scheme, which is a fixed ratio method, proved itself in principle<sup>13</sup>, but that it could be improved in certain aspects.

The introduction of RBC through the NAIC was accompanied by several studies of its historical as-if performance and further studies<sup>14</sup> of its actual performance followed. These studies show that overall, the predictive power of RBC is recognised to be low.

*Scenario based / Probabilistic approaches*

We are not aware of many studies that test the predictive power of scenario based approaches. One such study, however, was by Cummings, Grace and Phillips (1999)<sup>15</sup> which concluded that “*the cash flow simulation variables add significant discriminatory power to the solvency prediction models based on the RBC system...Thus, dynamic financial analysis appears to hold significant promise for providing regulators with better predictions of insurer insolvency.*”

As for probabilistic approaches, due to the complexity of these approaches empirical validation of their usefulness is difficult. Empirical testing would require modelling of many companies with the associated volume of data and, therefore, these approaches rely more on the validity of design rather than on empirical validation of their performance.

***Complexity****Fixed Ratios / RBC*

A significant advantage of the fixed ratio approach is its simplicity, both in terms of calculation and data requirements.

The US RBC approach has a relatively simple underlying design, but the number of factors applied, the adjustments for the company-specific experience and for risk concentration, and the covariance formula create complexity.

Further, an elaborate approach with many factors or risk weights can be difficult to implement. This is due to the fact that the weaknesses in the definition of the factors and the risk category aggregation do not provide much guidance for a modular calibration (ie factor by factor). An

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<sup>13</sup> See the Muller report, section 2.3, p 12.

<sup>14</sup> See also Cummings, J.D., Harrington, S. and Klein, R. (1995) Insolvency Experience, Risk-Based Capital, and Prompt Corrective Action in Property-Liability Insurance, *Journal of Banking and Finance*, 19: 511-527.

<sup>15</sup> Cummings, J.D, Grace, M.F. and Phillips, R.D. (1999) Regulatory solvency prediction in Property-Liability insurance: Risk-Based Capital, Audit Ratios, and Cash Flow Simulation. *The Journal of Risk and Insurance*, Vol. 66, No. 3, 417-458.

acceptable and adequate set of parameters will have to rely heavily on testing the effects of the total factor set.

### *Scenario based / Probabilistic approaches*

Basic static stress tests are not complex. The complexity of advanced scenario based approaches can be considerably greater, due to the use of a dynamic financial model<sup>16</sup>.

Although scenario based models might contain considerable complexity, the deterministic calculations and the use of scenarios enable a good intuitive understanding of the results.

Probabilistic approaches are even more complex than scenario-based approaches, due to the consideration of the probability of scenario occurrences. Advanced models involve the combination of many sub-models. Often these models were created for purposes other than risk assessment and capital requirements. In addition, the level of sophistication and reliability of the sub-models may vary considerably.

Due to their complexity probabilistic approaches can demonstrate sensitivity to input variation, which can impair the understanding of the results. Further, the results are a statistical aggregation of simulation output, which counteracts intuitive understanding and validation of the results. Therefore, despite the presence of a clear capital definition, understanding of the capital requirement is difficult.

The need to find parameters which correctly reflect extreme events does not allow for a straightforward calibration and validation. Further the non-linear elements of probabilistic approaches can lead to considerable trial and error testing in order to find acceptable parameters.

### *Data*

The use of accounting data can generate significant distortions in the capital requirements produced by any considered approach. This problem is not necessarily restricted to fixed ratios and RBC, as more advanced approaches rely on provisions, premiums and asset values as well. In addition, accounting data often gives a poor representation of risk.

Insurance companies retain and capture a significant amount of data but that data is generally not kept and organised in a way that supports company-wide risk assessment. This often makes internal company-wide risk modelling costly and creates many situations where data may be substituted with approximations or guesses.

### *Fixed Ratios / RBC*

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<sup>16</sup> The complexity of the financial model can be scaled, and relatively simple, but meaningful models can be built, for example Cummings, Grace and Phillips (1999) give an example of a relatively simple Dynamic Financial Model that is based on accounting data.

The data requirements for the EU methodology are minimal. The US RBC requirements are considerably higher, but based on already available statutory data. Adjustments for asset and liability concentration and for provision development on a company-specific basis require specific data preparation.

### *Scenario based / Probabilistic approaches*

Static scenario tests may have few data requirements. As a minimum, exposure data is required so that the impact of the scenario can be established.

For more advanced approaches, parameters representing the timing and cash flow consequences of the impact have to be established. Projections of business plans, dynamic risk scenarios and details of protections such as reinsurance are required. Probabilistic approaches require additional parameters for the probabilistic risk drivers. The data requirements for model design and application greatly increase with the complexity of the approaches.

### **Subjectivity**

#### *Fixed Ratios / RBC*

The EU fixed ratio approach is codified and rigid and does not leave room for subjectivity. The US RBC approach leaves some flexibility for applying or adjusting factor values to specific experience, but there is no room for subjectivity. However, the implementation of such approaches entails subjectivity and arbitrariness, due to the weakness of the capital definition.

#### *Scenario based / Probabilistic approaches*

Advanced scenario based and probabilistic approaches require large parameter sets, which can create considerable room for subjectivity.

The necessity for subjective approximation increases with complexity and flexibility, as many parameters for a rigorous approach (scenario based and probabilistic) will not be estimable from data and will have to be calibrated or approximated based on assumptions. Subjectivity is therefore inherent in advanced scenario based and probabilistic approaches.

The following issues are the most important sources of subjectivity for scenario based and/or probabilistic approaches (by implication these problems are inherent in fixed ratio and RBC approaches as well):

- occurrence probabilities for adverse scenarios;
- tail probabilities per driver;
- interaction of many drivers;
- impact of specific external developments and events;
- timing elements (e.g. development and payment patterns);

- exposure and premium projections;
- division of aggregate data into groups using proxies and assumptions (due to lack of data records with sufficient detail).

### *Compliance Cost*

The main compliance costs for the approaches are:

- requirements on reporting systems;
- development and maintenance of modelling software;
- data preparation, including adjustments to data and to parameters;
- processing and analysing the result.

### *Fixed Ratios / RBC*

The EU regime does not impose any significant cost. Similarly, the US RBC, although more detailed, does not impose significant costs.

### *Scenario based / Probabilistic approaches*

Scenario testing procedures that are currently implemented for supervisory purposes do not appear to impose significant cost. Even for more sophisticated dynamic variations, simple implementations are possible, which do not require substantial additional cost regarding model building and data compared to fixed ratio or RBC approaches of comparable scope. However, advanced scenario based approaches require additional effort for:

- calibration of impact and timing parameters;
- definition of scenarios;
- projections of premium and exposure data;
- analysis of the results; and
- sensitivity analysis.

For probabilistic approaches, additional costs over and above the costs identified for scenario based approaches are incurred in respect of building the model, calibration and analysis. A probabilistic model is costly, due to the requirement of simulation and sampling procedures.

### *Standardisation & codification*

#### *Fixed ratio / RBC*

Fixed ratio and RBC approaches can be codified. However, an effective risk-sensitive implementation requires company-specific adjustments regarding data and factors.

### *Scenario based / Probabilistic approaches*

Simple scenario-testing is capable of being codified. This extends even to simple dynamic versions. However these approaches are likely to require flexibility for company-specific adjustments and assumptions regarding impact modelling, timing considerations (such as development patterns) and perhaps even regarding the scenario definition.

Experience in the use of probabilistic models for risk management shows that, at the current state of development, probabilistic approaches are never applied without significant approximations, assumptions and calibrations. Probabilistic approaches are too complex for efficient codification.

### ***Strengthening of risk management processes***

#### *Fixed Ratios / RBC*

The EU fixed ratio and the US RBC regime do not provide any direct incentive for improved risk management.

#### *Scenario based / Probabilistic approaches*

Despite the fact that more complex approaches might not be able to achieve the theoretically desired objectivity and validity, the application of more sophisticated scenario based and probabilistic models can have additional strengthening effects on risk management by:

- creating focus and awareness;
- improved evaluation of individual risk (even if the total enterprise risk cannot be reliably established);
- obtaining information on risk exposures;
- improved assessment of the relative importance of the risks;
- explicit consideration of the effect of strategies and risk management decisions on risk.

Regulatory supervision that encourages the use of these approaches will therefore be beneficial.

## Discussion of a possible framework for a future solvency system

As described in chapter 10, the current European solvency system, based on fixed ratios, suffers from several weaknesses, the most important ones being:

- **Distorted assessment of available capital:** The differences in asset valuation and provision setting, both in national rules and in practice, make the comparison of available capital amounts difficult.
- **No clear definition of the capital requirement objective:** The current system does not state clearly for which risks capital charges have to be established and what level of security the capital requirement attempts to achieve.
- **No recognition of asset risk and of non-life long-tail risks:** Asset risk does not lead to an explicit capital charge and the important reserving risk for non-life long-tail business is inadequately reflected in the application of premium or loss factors.
- **Inadequate recognition of reinsurance, ART, ALM and diversification effects.**
- **Inadequate recognition of the risk characteristics of different lines of business:** The risk characteristics of different lines of business are inadequately reflected in the application of a single premium or loss factor.

### *Accounting Issues*

In various parts of the study, the lack of consistency between Member States is indicated as a barrier to the development of a more advanced system of capital requirements for insurance undertakings. This is particularly the case where assets and technical provisions are concerned. Accounting principles and practices are important because they form a basis for supervisory review. Chapter 8 of this study considers developments in accounting which will have an impact on the solvency system. It notes that greater consistency between Member States will only be achieved through the implementation of compliance with International Accounting Standards for both listed and unlisted companies, or reform of the European Insurance Accounts Directive (or both). The following discussion assumes that, one way or another, greater consistency will be achieved.

### *Integrated Financial Services Regulation*

In the light of the convergence in the financial sector and of the increasing risk transfers taking place between the banking and the insurance sectors, there are clear benefits to harmonisation of the regulation of the financial sector (although appropriate differentiation needs to be maintained where harmonisation is inappropriate). This will require that risks are approached consistently in a more generic manner.

### *Outline of a possible capital requirement regime for the EU*

In order to improve upon the current European fixed ratio (factor based) system, capital requirements need to be based on a clear definition of the risks they should protect against and of

the intended level of security they are trying to establish. The capital requirements should adequately recognise the company's net aggregate risk stemming from:

- insurance risk;
- market risk;
- credit risk.

Asset liability mismatching risk could be addressed by the insurance and market risk factors, or alternatively could be dealt with in another manner.

Ideally, the capital of an insurance undertaking should provide a buffer against all kinds of risk events that can occur (given an agreed level of security), and this gives rise to the question of the extent to which operational risk should be incorporated in capital requirements. Further, the quantification of operational risk is less reliable than the quantification of the other risks mentioned above. It is questionable whether it is effective to charge capital amounts for a risk which cannot be quantified with some reliability, and where an effective proxy cannot be established. The way forward for addressing operational risk may be based on the developments in the Basel proposals.

Factor-based approaches do not provide a comprehensive framework recognising all types of risks. Probabilistic models provide, theoretically, the best tool for capital requirement calculations. However, the practicality issues involved preclude basing capital requirements entirely on the use of probabilistic models. Accordingly, a system that places strong emphasis and reliance on scenario test approaches would probably provide the best balance between practicality and effectiveness.

A possible approach might consist of three tiers, which allows insurance undertakings to calculate their capital requirements using any one of the following approaches:

- 1 a fully codified factor based approach;
- 2 a scenario-based approach, applying a pre-defined scenario set, but leaving some room for company specific assessment in the calculation of the scenario results;
- 3 an advanced model approach, applying probabilistic models.

Such an approach could require an undertaking to select any of the three approaches, but once chosen, a further change would only be possible in the direction of more advanced approaches, with the objective of encouraging undertakings to move in the direction of more powerful techniques.

### *The factor-based approach*

This element could be a default approach, which can be calculated even by the least sophisticated undertakings. The factors should be chosen so that the overall result is conservative, thereby encouraging undertakings to move forward towards a more advanced approach. The approach would not need to attempt to solve the main issues mentioned above, as this only leads to complicated codification, while little technical improvements are achieved. However, this does not preclude a simple risk based approach, by which any of the above weaknesses could be met

by conservative factor choices. Asset and long-tail risk could be recognised by introducing new factors applicable to asset values and provisions/premiums.

*Scenario-based approach*

In the suggested three tier system, the most weight could be placed on the use of scenario-based capital requirements. Such approaches provide significant technical advantages over factor-based calculations. They provide adequate treatment for all the main issues. The principal exception is diversification, which can at least for assets be prescribed by admissibility rules such as are available to most supervisors at present. At the same time, they do not create the necessity to create complex simulation models. They can be prescribed and codified to a satisfactory degree, while still allowing for some flexibility in order to allow for company-specific aspects in the calculation. They are much easier to understand and much more transparent than advanced simulation models. In comparison to factor-based approaches, they do not only improve on the adequacy and relevance of the result, they are also much easier to communicate, as the scenarios bear concrete meaning. A capital requirement based on scenarios is therefore clearly and firmly grounded. It is easier to discuss the relevance and completeness of a scenario set than to search for the elusive correct level of a factor/risk weight.

Rather than defining specific scenarios which may not be appropriate when applied within all Member States, and which may need to change over time, certain criteria could be defined. In defining the criteria, key aspects which would need to be considered would be:

- the scenario set should cover all insurance and financial risks;
- the scenario set should be updated on a regular basis;
- the scenarios should consider run-off of existing business and of one or two years of new business and the closing down cost;
- the number of scenarios should be kept small. There will be a trade-off between improved recognition of insurance risk details and a manageable number of scenarios;
- the scenarios should not be a simple replication of historical downsides, but the relation to those should in any case be clearly identified;
- the scenarios should cover event and trend risk;
- the scenario set should address risk concentration;
- the scenario set should be codified, but the calculation of the scenario results should be left to the individual insurance undertaking, in order to make allowance for the use of specific risk data and for incorporation of the effects of the undertaking's own financial projection instruments. The undertaking would need to document its approach and calculation and would have to provide proof for the regulator that the results are prudent.

The actual scenario set definition will be critical for the implementation of an efficient and effective system. Scenario definitions might ask for consideration of specific asset value deteriorations, and adverse developments in loss experience and provisions. A scenario can be

formulated in very strict terms, for example by prescribing the evaluation of the adverse results by using premium volumes and provisions for specific lines of business. But scenarios can also be defined in a more general and abstract manner.

Reference to specific lines of business can be loosened by using criteria which allow for the inclusion of the most relevant lines of business for a specific undertaking. Adverse development can be described in relation to historical undertaking-specific or market-specific experience rather than in fixed terms. Further alternatives in the description of adverse development are given by either defining the concrete financial effect (for example a 30 percentage point increase in loss ratio for a specific class) or by focusing more on the underlying triggers of the development (for example a 50% drop in rate levels combined with a 100% increase in loss count and a 15% inflation rate). Possibly an effective scenario set will have to combine both elements:

- A crude and highly codified scenario set will be very close to factor-based approaches, whereas elaborate scenario sets, and those which are defined in more abstract terms, can come close to advanced risk models. It is necessary to find the right balance.
- A crude and strict scenario approach is prone to inappropriate recognition of specific risks, and is likely to lose the flexibility advantage that allows the incorporation of company specific risk data and risk transfer instruments.
- A strictly codified set is likely to require a large number of scenarios in order to capture all relevant lines of business. There is a risk that the codified set is incomplete.
- A more abstract scenario definition is prone to the danger of leaving room for interpretation, and for the undertaking to manipulate the scenario result. It is more demanding on both insurance undertakings and supervisors.

Practical advantages of scenario sets:

- The greatest practical advantage of scenario sets becomes apparent in the calibration process. Scenarios are concrete, it is therefore possible to discuss their relevance and appropriateness. Loosely speaking, a scenario has meaning, a factor has not.
- Capital requirements from scenarios tend to be based on the worst scenario result. Scenarios can therefore be discussed and calibrated in greater isolation than risk-based factors.

### *The advanced model approach*

Internal risk models in insurance are less standardised than in banking. This makes a theoretically desirable incorporation into supervision more difficult. The definition of certification criteria will provide a significant challenge.

Clearly some form of validation is necessary, in order for a model to be certified. In some cases, the validation of modelling parameters and assumptions may be prohibited by the inadequacy of historical data records. The certification will need to address the aspects of structural validity (financial modelling structure, implementation) and application (correctness of the modelling data, identification and stress-testing of critical assumptions).

In addition to the need for validation, the basic criteria identified in chapter 3 of the study, in respect of the recognition of internal models by supervisors in the banking sector, is also relevant. These are the ability of a model to provide quantified measures, based on objective parameters, and the use of the model as an integral part of the undertaking's approach to risk management, used in the business as a basis for making decisions.

## Glossary of Abbreviations

ALM	Asset Liability Management
APRA	Australian Prudential Regulatory Authority
ART	Alternative Risk Transfer
BIS	Bank of International Settlements
CAD I	First European Capital Adequacy Directive
CALM	Canadian Asset Liability Model
CAR	Capital Adequacy Ratio
CIA	Canadian Institute of Actuaries
DCAT	Dynamic Capital Adequacy Testing
DFA	Dynamic Financial Analysis
DSOP	Draft Statement of Principles
FASB	Financial Accounting Standards Board (USA)
FSA	Financial Services Authority (UK)
FSV	Financial Soundness Valuation (South Africa)
GAAP	Generally Accepted Accounting Practice
IAD	EU Insurance Accounts Directive
IAIS	International Association of Insurance Supervisors
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IASC	International Accounting Standards Committee
IBNER	Incurred But Not Enough Reported
IBNR	Incurred But Not Reported
IFRS	International Financial Reporting Standard
IRIS	Insurance Regulatory Information System, (NAIC)
JWG	Joint Working Group
LIASB	Life Insurance Actuarial Standards Board (Australia)
LIBOR	London Inter-Bank Offer Rate
MAT	Minimum Asset Test
MCCSR	Minimum Continuing Capital and Surplus Requirements
MCR	Minimum Capital Requirement
MCT	Minimum Capital Test
MOS	Margin on Services methodology
MPL	Maximum Probable Loss
NAIC	National Association of Insurance Commissioners (USA)
OECD	Organisation for Economic Co-operation and Development
OSFI	Office of the Superintendent of Financial Institutions (Canada)
PADS	Provisions for Adverse Deviation
P&L	Profit and Loss
PARC	Program for Assessment of Regulatory Compliance (Canada)
PVK	Pensioen- & Verzekeringskamer (Netherlands)
REMOS	Reinsurance Monitoring System
RBC	Risk Based Capital
RMM	Required Minimum Margin
SMR	Solvency Margin Requirement
SORP	Statement of Recommended Practice on Accounting for Insurance Business, (Association of British Insurers, (ABI))
SPV	Special Purpose Vehicle
TAAM	Test of Adequacy of Assets in Canada and Margin Requirements
UCITS	Undertaking for Collective Investment in Transferable Securities
ULR	Ultimate Loss Ratio
VaR	Value at Risk

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