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RE-EXPOSURE DRAFT

MEASUREMENT OF LIABILITIES FOR INSURANCE CONTRACTS:

CURRENT ESTIMATE AND RISK MARGINS

24 March 2008

Prepared by the ad hoc Risk Margin Working Group

Comments to be sent to katy.martin@actuaries.org by 23 May, 2008

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1. Executive Summary

The ad hoc Risk Margin Working Group (RMWG) of the International Actuarial Association (IAA) initiated the research effort used in the development of this paper to identify issues surrounding potential future practices for measuring insurance contract liabilities.

The scope of the paper is intentionally broad to provide information useful for numerous methods of financial reporting, including both public financial reporting and regulatory reporting. While we recognize that there are different goals for different types of reporting, many underlying concepts are still equally applicable. This is especially true because the International Association of Insurance Supervisors (IAIS) has stated a desire to use the International Accounting Standards Board (IASB) as the basis for regulatory reporting, although with some expected adjustments.

The IASB identified three building blocks for the measurement of insurance liabilities, as detailed in the May 2007 discussion paper issued by the IASB on the "Preliminary Views on Insurance Contracts". These three building blocks are:

1. Contractual cash flows – "explicit, unbiased, market-consistent, probability-weighted and current estimates of the contractual cash flows."
2. Discount rates – "current market discount rates that adjust the estimated future cash flows for the time value of money."
3. Margin over current estimates – "an explicit and unbiased estimate of the margin that market participants require for bearing risk (a risk margin) and for providing other services, if any (a service margin)."

This paper focuses on the issues that would impact these three building blocks.

Current estimates: contractual cash flows and discounting of those cash flows

"Current estimates" are the unbiased probability-weighted expected (mean) values of future cash flows, discounted for the time value of money, and comprise the bulk of insurance contract liabilities. Current estimates reflect the financial effect of all relevant contractual rights and obligations, including the expected effect of all contractual options and guarantees, and all relevant contract features, cash flows, and risks. The potential cash flows from future catastrophic or calamity risk are considered within the current estimates with appropriate recognition of the probability of those events.

Current estimates are just that…estimates. Assumptions are needed in the estimation process and are explicit (to the extent practical), applied consistently in the measurement, especially where the assumptions are inter-related, and are reasonable on an individual basis (where material) and in the aggregate. For practical reasons, approximations can sometimes be used; however, the estimates still need to be reasonable and be performed in a technically sound manner.

Historical or current experience data is often the best source from which current expectations are derived. However, the data often needs to be adjusted to more accurately assess the prospective cash flows on a current basis.

Practically, it may not be feasible to separately identify every possible cash flow scenario, nor is it necessary to perform highly sophisticated analyses with the development of probability distributions for all cases. However, in any case the range of possibilities would be considered and current estimates need to be consistent with the scope and objective of the estimation that is being made.

Market-consistent

The IASB definition of cash flows to be considered includes the statement that the current estimate should be "market-consistent". For the large majority of contracts offered by insurers, market-based inputs are either not available or available only for certain measurement assumptions, usually restricted to financial assumptions. Therefore, we believe that "market-based" is not the same as "market-consistent" and reporting standards may need to provide some guidance on the selection of inputs and calibration sources in order for the idea of "market-consistency" to be implemented in insurance contract measurement.

For insurance contracts, we expect a model to be used in most cases, with inputs into the model based upon relevant and reliable portfolio-specific information. When such data is not available, similar relevant data, such as industry experience, would be appropriately adjusted and used. Selections and evaluations of appropriateness are expected to require professional evaluation and judgment.

Discounting

The objective of applying a discount rate to a future cash flow is to reflect the time value of money. The question of which discount rate to use for this purpose does not have an easy answer and often depends upon the financial reporting requirements and objectives, and the timing of the cash flows.

Candidates for the discount rate basis used consist of risk-free rates, high quality corporate bond rates, expected entity-specific investment earnings, current or initial credited rates, and imputed interest rates. Since there is no such thing as a pure risk-free rate, consideration as to what the basis of such a rate is needed. Also, consideration as to whether an adjustment should be made for liquidity, given that liability cash flows are less liquid than the risk-free assets.

Another consideration when selecting the discount rate to be applied is whether the rate is consistent with the assumptions in the cash flows. For example, when the contract's obligation is directly linked to the performance of specified assets, a discount rate that matches the earnings on the designated portfolio of assets may be appropriate. In addition, it would be inappropriate to double-count any risk adjustment.

Margin over current estimates: risk margin

Using a market-consistent methodology, the transaction price is effectively the summation of the current estimate and the margin. The current estimate relates to the expected cash flows, whereas the margin includes an allowance for risk that is inevitably included in a transaction price. Effectively, the margin over current estimates in an efficient market is then equal to the "estimated market price minus the current estimates". However, without a deep and liquid secondary market for insurance contract liabilities, the risk margin will need to be modeled.

The definition of the margin can be viewed from different perspectives. The margin can be seen as the reward for risk bearing, as the measurement of the inherent uncertainty in the estimation of insurance liabilities and in the future financial return from the contract, or in a solvency context as the amount to cover adverse deviation that can be expected in normal circumstances (with capital to cover adverse deviation in more unusual circumstances). In a market-consistent world, these different perspectives would result in the same outcome.

Desirable risk margin characteristics

The IAA, IAIS, and the IASB all agree on five expected risk margin characteristics, as originally published by the IAIS:

1. The less that is known about the current estimate and its trend; the higher the risk margins should be.
2. Risks with low frequency and high severity will have higher risk margins than risks with high frequency and low severity.
3. For similar risks, contracts that persist over a longer timeframe will have higher risk margins than those of shorter duration.
4. Risks with a wide probability distribution will have higher risk margins than those risks with a narrower distribution.
5. To the extent that emerging experience reduces uncertainty, risk margins will decrease, and vice versa.

The IAA offers the following additional risk margin characteristics that take risk mitigation into account:

6. To the extent that the observed experience of a portfolio is uncertain, due to effect of a lack of credibility of the experience, the risk margin should be higher. As the size of the relevant historical experience increases, there is a diminishing marginal impact on the risk margin.
7. As diversification increases, the risk margin should be smaller.
8. With increased use of off-setting risks, the risk margin should be smaller.
9. A portfolio with contract adaptability features tends to have a lower risk margin than a portfolio without these features.

Risk margin approaches

Approaches for determining risk margins have been grouped into the following four families of approaches that meet the IASB's requirement to have an "explicit" risk margin:

1. **Quantile methods** use percentile/confidence levels or related calculations such as the conditional tail expectation (CTE), tail value at risk (TVaR), or multiples of the second and higher moments of the risk distribution.
2. **Cost of capital methods** are based on the amount of return, in addition to the amount earned by the insurer from its investment of capital, that is required for the total return on the insurance enterprise to be adequate.
3. **Discount related methods** discount future expected cash flows using the risk-free interest rate minus a selected risk adjustment(s).
4. **Explicit assumptions** use required inputs or simpler methodologies such as the use of specified data (e.g. mortality table), a minimum loss ratio, or a fixed percentage risk margin.

Comparison of risk margin approaches

We have evaluated each of the four main risk margin approaches. In general, we observe that for products with narrower risk distributions (meaning without the low frequency and high severity losses), similar risk margins are easily produced by the different methods. As the product becomes more risky, the risk margin amount becomes increasingly sensitive to the method used.

Overall, the cost of capital method is the best fit to the IAIS and IASB guidance on desirable risk margin characteristics and, at least in theory, specifically addresses the IASB's market consistency characteristic. The quantile method is another strong candidate to meet those goals. With consideration of the cost of reporting systems and practicality (such as the ease of calculation and the ability to maintain consistency across entities), the explicit assumptions and discount methods are also possible candidates, particularly as useful approximations for implementing approaches such as the cost of capital or quantiles. An important issue is which approach would best facilitate appropriate calibration. Whatever method or combination of approaches is applied, it needs to be consistent with other reporting requirements and determined in a manner consistent with accepted actuarial methodologies, where possible.

Reference portfolio/entity concept

To achieve market-consistency in the insurance contract liability values, the concept of using a reference portfolio or entity has been discussed. This implies that the individual entity experience or data would not form the sole basis of measurement. Measurement would be done with an eye toward how a typical quality-rated insurer would act and how that insurer would value the insurance portfolio in the market. The "quality-rated insurer" would then be the reference entity. Obviously, a definition of this reference entity is

needed. We offer one in this paper, but an associated issue arises from the fact that since this would be a fictitious entity, there would not be observable data available from which to calibrate. Many believe this issue can be overcome, so further research and discussion are required.

Rules and constraints

With all of this said, there may be rules or constraints to assumptions and methods because of financial reporting or regulatory requirements or restrictions. Constraints that may impact decisions might include which cash flows will be allowed to be included in the measurement, whether certain or all cash flows must be market-based or not, whether values should be based on "transfer value" or "fair value" concepts, which assumptions must be used (e.g. discount rates, mortality), and whether profit is allowed to be recorded at the issuance of a contract. In addition, rules or constraints on the development of assumptions and methods used can create inherent difficulties in developing estimates of the interrelationships between assumptions.

Additional Information

As might be expected, there is a significant amount of additional information within this paper, including an elaboration of the advantages and disadvantages for each group of risk margin approaches. Included in the appendices are several examples of the estimation of risk margins and a discussion of specific assumptions and inputs useful in the measurement of current estimates.

2. Objectives of Paper

This paper was prepared by the ad hoc Risk Margin Working Group ("RMWG") of the International Actuarial Association ("IAA") in response to a request of the Solvency and Actuarial Issues Subcommittee ("Solvency Subcommittee") and Insurance Contracts Subcommittee of the International Association of Insurance Supervisors ("IAIS"), as described in Appendix E of this paper.

The background leading to the formation of the RMWG is described in Appendix E1, its Terms of Reference is given in Appendix E2 and the process it has followed in the development of this paper is outlined in Appendix E3.

In the course of the development of this paper, the RMWG has also considered the application of these issues in the context of the simultaneous development of an updated standard for general purpose financial reporting being considered by the International Accounting Standards Board ("the IASB"). However, it was not developed to provide comments on its proposals. Neither is it intended to serve as an actuarial standard that could be used for application of any IAIS guidance or IASB standards. Nevertheless, some of the information included in this paper might serve as a useful basis for future development of actuarial guidance.

As outlined in Appendix E2.3, the objectives of this paper are focused on information that the RMWG hopes will prove useful in both regulatory and general purpose financial reporting in the following areas:

- Determining the basis of actuarially sound methodologies and assumptions that might be used to determine current estimates[1] (without risk margins) incorporated in the measurement of the liabilities of insurance contracts (in some jurisdictions referred to as 'technical provisions' or 'actuarial reserves') for use in regulatory and general purpose financial reports.
- Determining risk margins appropriate for the measurement of the liabilities for insurance contracts for regulatory and general purpose financial reports.
- Assessing the appropriateness of current estimates and risk margins in the measurement of the liabilities for insurance contracts.

Although this paper includes a description of certain current approaches to key aspects of the measurement of liabilities for insurance contracts, it is not an exhaustive source of these practices, nor indeed does it address the wide variety of current types of contracts offered in the insurance marketplaces around the world. As a result, it is not

[1] The original request of the IAIS referred to "best estimate" rather than "current estimate." Subsequently in its *Second Liabilities Paper* the IAIS adopted the terminology "current estimate," defined as "the expected present value of probability weighted cash flows using current assumptions" and "margin over current estimate," referring to the margin reflecting the level of uncertainty in the calculation of the current estimate. In this report, the RMWG has adopted the terms "current estimate" and "risk margin", respectively, as standard terminology, although the latter is also referred to as "margin over current estimate" or for short, "margin."

intended to provide a comprehensive survey or identify the single best practice, in part because different circumstances, types of contracts and insurance claims might be best measured by different actuarial techniques. In many cases, more than one method may be acceptable, depending on the financial reporting standards and circumstances that apply.

This paper emphasizes principles that might be used for such purposes and intentionally does not focus on specific rules or techniques that might be used. However, for illustrative purposes it explores certain methodologies and concepts that might be of general use.

As an important objective of this paper is to identify and discuss relevant issues, it provides examples in both the text and in its appendices to help explain the issues involved in the measurement of liabilities of insurance contracts and their components, in the context of general purpose and regulatory financial reports.

The content of the paper follows, to some extent, the measurement building blocks proposed in the IASB Discussion Paper on Insurance Contracts published in May 2007:

- An introduction and context for measurement is provided in Section 3.

- Considerations in developing expected cash flows are discussed in Section 4. Note that some of these considerations also apply to the development of estimates of risk margins considered in Section 6. A further discussion of probability distributions used in the course of this paper is given in Appendix A. Specific assumptions/inputs are discussed in Appendix D.

- Discounting bases and applicable considerations are discussed in Section 5.

- A discussion of the objectives and methodologies that can be used in estimating risk margins are given in Section 6, with additional examples of application to life and annuity contracts in Appendix B.

- Other factors considered in the measurement process, particularly regarding mitigation techniques associated with insurance contracts, are principally discussed in Section 7, with a discussion of the treatment of some of the techniques also included in Section 6 and Appendix C, particularly with respect to diversification.

- Several miscellaneous topics are covered in Section 8, including the role of service margins, margins under a system that does not recognize a profit at initiation of a contract, operational risk and corporate governance as it applies to the measurement of liabilities of insurance contracts.

3. Introduction to Measurement

3.1 Purposes of measurement

One of the most significant functions of actuaries who practice in insurance is the measurement and valuation of the expected cash flows of insurance and related contracts. The types of applications of this measurement include:

- Calculating financial reporting and regulatory values
- Assessing capital for regulatory compliance, economic capital determination, and allocation
- Pricing and product management
- Strategic planning and financial management
- Analyzing mergers and acquisitions
- Developing performance metrics and internal management reports.

Although the basis for values used for these purposes have varied by application and jurisdiction, some fundamental principles are common to all. They can differ, in some cases significantly, in response to the specific context and requirements in which they have been developed and the basis for assumptions under which they were applied. As described in Section 2, this paper is focused on values determined for financial reporting and regulatory purposes. Even in these limited areas, a wide range of principles and rules have historically been applied. As a result, it is difficult to develop and describe a single approach for all of these measures. For instance, measures developed for solvency related purposes may or may not generate values different than those for general purpose accounting. Nevertheless, methods used to derive these measures for various purposes have been gradually converging over time, as it has been increasingly recognized that the underlying expected costs and their associated uncertainty need to be recognized and measured in a realistic manner.

The process used to determine estimates of the expected financial effects of the rights and obligations associated with the contracts within the scope of this paper is referred to as the 'measurement of liabilities of insurance contracts'. Note however, that (1) the liabilities referred to might be assets, e.g., when they are associated with ceded reinsurance business rather than with directly written or assumed reinsurance business, (2) such estimates have been given different labels in different contexts and different jurisdictions, e.g., the IAIS has often referred to them as 'technical provisions' and in certain jurisdictions they have been referred to as 'actuarial reserves' and (3) different accounting frameworks may require or suggest alternative methods and types of assumptions to be used.

Particularly for regulatory purposes, some of the uncertainty or risks associated with the rights and obligations under the contracts within the scope of this paper are reflected in the assessment of required and desired levels of capital, rather than in the liabilities. The measurement of the total of the liabilities and all of its

associated risks has been referred to as a total balance sheet approach. Note that the measurement of the capital that forms a part of the total balance sheet is outside of the scope of this paper.

It is not the purpose of this paper to identify, discuss and compare the methods and types of assumptions used for all of these measures. Focus will be placed on a discussion of measurement approaches that are currently used and that are expected to be used in the future in international accounting and regulatory contexts.

3.2 International standard setter developments

Significant discussions regarding the development of a revised framework for the financial reporting of insurance contracts are currently underway for both general and regulatory purposes. As part of that process, the IASB exposed for comment its Preliminary Views on Insurance Contracts, part of Phase 2 of its project on accounting for insurance contracts. These Preliminary Views propose an exit value approach, which, in the absence of a sufficiently active and relevant market for insurance contracts to observe these values, takes a prospective view at the reporting date that reflects the amounts required for the insurer to transfer the rights and obligations of the insurance contracts. It is anticipated that some of the concepts involved in Phase 2 of the IASB's project will likely continue to evolve in the near future as the IASB moves toward the exposure draft and adoption stages of their project.

Separately, but not completely independently, are developments by the International Association of Insurance Supervisors (the "IAIS"). *The IAIS Common Structure for the Assessment of Insurer Solvency* (2007) has adopted similar principles. Although the IAIS in its *Second Liabilities Paper* (2006) expressed the desire to use the IFRS as the basis for regulatory reporting, it is not yet certain the extent to which the two organizations will end up using the same methodology.

This contrasts with current practice. From a regulatory perspective, in many jurisdictions historically, a regulatory emphasis toward the measurement of liabilities (referred to by the IAIS as "technical provisions") for insurance contracts has emphasized the protection of the insurers' policyholders. This has often been accomplished by guidance that encouraged or required insurers to establish a prudent measurement of their liabilities, sometimes through the use of implicitly conservative assumptions, to help ensure that the insurer's total financial resources would be sufficient to meet its obligations even under adverse circumstances. This was particularly true for jurisdictions in which current regulatory requirements were introduced before the introduction of more risk-based capital requirements.

Regulators are also concerned with the level of surplus an entity maintains that provides a minimum level of assurance that its policyholder obligations will be

adequately met. Regulatory and general purpose reporting systems differ from each other considerably around the world, resulting in financial reports that some view as being non-comparable and opaque. The current movement in both areas is to enhance reporting and converge to the extent possible by producing financial statements that are consistent, transparent and representative of the entity's actual performance, while still achieving the objectives of each of the financial reporting systems.

According to the IASB's *Framework*, a liability is "a present obligation of the entity arising from past events, the settlement of which is expected to result in an outflow from the entity of resources embodying economic benefits." In the context of the types of insurance contracts within the scope of this paper, unless reliable and relevant prices for the obligations can be observed, a liability is primarily a prospective measure of the unpaid amounts of the obligations and rights associated with the contracts. One definition of the components of the liability for a portfolio of insurance contracts at a certain (reporting) date is that they would consist of a current estimate of the expected future cash flows associated with an obligation generated by a portfolio of insurance contracts[2] and a margin for risk.

The IAIS has expressed the view that:

> "(t)he IAIS believes that it is most desirable that the methodologies for calculating items in general purpose financial reports can be used for, or are substantially consistent with, the methodologies used for regulatory reporting purposes, with as few changes as possible to satisfy regulatory reporting requirements." [IAIS *Second Liabilities Paper*, Executive Summary]

This view was expanded upon in the following:

> "As the international standard setter for insurance supervision, the IAIS is concerned with both general purpose accounting and with solvency issues. The IAIS believes that it is most desirable that the methodologies for calculating items in general purpose financial reports can be used for, or are substantially consistent with, the methodologies used for regulatory reporting purposes, with as few changes as possible to satisfy regulatory reporting requirements. Indeed many, but not all, IAIS jurisdictions currently base their regulatory reporting requirements on general purpose financial statements, or at least on equivalent quantities determined using the same methodologies as for those financial statements. Hence, the IAIS and other international regulatory organisations believe that an open and constructive dialogue between the IASB and prudential standard setters is essential.
>
> "There is widespread support for an effort to achieve a single set of accounts that could be utilised for both general purpose financial reporting

[2] The portfolio may include insurance contracts no longer inforce, in the case of unsettled claims.

> and regulatory reporting, notwithstanding the potential differing purposes of such reports. Achievement of this aim is likely to reduce costs and workload for regulated insurance entities.
>
> "Although it is clearly preferable for the insurance contracts measurement model for regulatory reporting to be consistent with that used for general purpose financial reporting, this may not be possible or appropriate in all cases. However, the IAIS believes that it is essential that differences between regulatory reporting requirements and general purpose reporting are reconcilable and that these differences are publicly explained. Otherwise there is a risk that public confusion will call into question the credibility of both reporting regimes." [IAIS *Second Liabilities Paper*, Introduction]

Because of the simultaneous evolution of financial reporting, actuarial, and regulatory thinking during the RMWG mandate, a key question is whether the direction taken in our work will further (or hinder) the desire for substantial consistency or convergence of general purpose and regulatory methodologies.

In "A Global Framework for Insurer Solvency Assessment" (2004, often called the *Blue Book*), which is a research report written by the IAA's Insurer Solvency Assessment Working Party, an entity's risks are assessed as to whether they should be reflected in the value of the insurer's liabilities for regulatory purposes or only assessed in connection with determining the minimum required capital of an insurer.

The conclusions expressed (slightly altered to recognize that underwriting risk involves both insurance and related risks and service risk in general purpose financial reporting parlance, as well as the effects of concentration risk as ameliorated by risk mitigation activities) are still generally viewed as appropriate by the RMWG and are given in Table 6.10. A review of these assignments may help to remove many (but not all) of the obstacles that might inhibit the IASB and the IAIS from using the same methodologies for the measurement of the liability of insurance contracts.

To the extent that risks reflected in premiums and charges are not reflected in liabilities, any difference will result in a profit to be recognized at issue (and vice versa).

While risk margins and capital both relate to providing for risks inherent in insurance contracts and in an insurance entity, they do not serve the same objective. Capital aims to ensure that an entity has sufficient financial resources to withstand a significant adverse deviation and still be able to satisfy its obligations to its policyholders. Hence, capital provides a given level of financial assurance that obligations to current and future policyholders will be met, while the risk margins discussed in this paper might be viewed as providing for what is usually a lower level of confidence above the current estimates, the price at which willing parties will transfer the obligation in an efficient market or the cost associated with obligations in excess of the current estimate. See Section 6.1 for a more complete discussion of this distinction and these viewpoints.

In addition, the allocation of risks between liabilities and capital can provide useful information in enabling liabilities, together with consistently valued assets, to provide a realistic measurement of performance and to facilitate comparison of financial statements both among insurers and between insurers and entities in other industries. In view of an increasingly global world of financial services, the IAA encourages the convergence of practice between jurisdictions, as well as between general purpose and regulatory financial reporting.

A detailed discussion of solvency issues is outside the scope of this paper, although to properly discuss some of the issues relevant to the measurement of liabilities of insurance contracts, the context of the total balance sheet in which the liabilities reside and the inter-relations between the treatment of risk within liabilities and capital are discussed where appropriate. Nevertheless, a discussion of liability measurement used in solvency assessment is a major topic discussed here.

A key proposition expressed by the IASB has been that the assets held by an insurer should not affect the measurement of the liabilities of insurance contracts, unless the obligations for which the liabilities provide change as a result of holding those assets. This financial reporting proposition is generally followed in this paper by reference to a replicating portfolio concept for the measurement of hedgeable risks for insurance contracts, with asset credit risk and market risk factors addressed outside of the measurement of liabilities.

It has been suggested that, if reflected in liabilities, credit risk and market risk would be reflected in different ways, depending on whether they are hedgeable. All such risks should be addressed in a regulatory solvency regime through “total balance sheet resources".

The recommended approach to reflecting the effect of risk mitigation techniques described in the *Blue Book* may not be completely consistent with current accounting developments. In Section 7 of this paper, risk mitigation and related issues, including the treatment of the effect of pooling, reinsurance, offsetting risks, diversification and certain contract features are developed. The IASB Board’s preliminary views concerning product adjustability including policyholder rights also may differ from the recommended approach. This topic is further dealt with in Section 7.7, focusing on participating policyholder dividends / bonuses and non-guaranteed contract features.

4. Current Estimates

4.1 Introduction

The objective of this section is to discuss factors that may be appropriate in the development of current estimates as part of the measurement of liabilities of insurance contracts[3]. Current estimates have sometimes been referred to as "best estimates[4]," although the latter term has sometimes also been used to represent the estimate of the value for the most likely (modal) possible outcome, rather than the estimate of the probability-weighted expected (mean) value of the possible outcomes. However, it is the mean value that will be discussed here and that most faithfully represents the current assessment of the relevant cash flows. In this paper, "current estimate" does not include the margin for risk included in liabilities for insurance contracts as discussed in Section 6, in contrast with some uses of the term "best estimate", such as in IAS 37, that does includes a risk margin. Both the IAIS and the IASB intend to use the concept of a current estimate in the sense of an expected value as the basis for measurement of the liabilities for insurance contracts.

Liability estimates reflect unbiased expectations of the obligations at the report date and are determined on a prospective basis. A current estimate represents the estimate of the expected present value of the relevant cash flows. For instance, in the case where the present value is based on a range of cash flows with a corresponding set of discount rates, the estimate reflects the probability-weighted present value of these cash flows.

What follows in this section is a discussion of the key characteristics of current estimates in the context of general purpose and regulatory financial reporting. Appendix D discusses specific inputs to their calculation, including those relating to mortality rates for life insurance and annuities, claims expectations, loss (and related expense) development for claims that have already been incurred, non-claims-related expenses, policyholder behavior and contract discontinuance rates. These are often referred to as actuarial assumptions.

As noted below, in developing current estimates there is a decision-making hierarchy to be followed. At a macro-level, this is based on a set of financial reporting standards (such as IFRS or regulatory) and the particulars of the

[3] References to liabilities of insurance contracts also include related items such as ceded reinsurance assets. Similar considerations might also be applicable to certain financial instruments that do not include significant transfer of insurance risk. However, the liabilities for those contracts are not in the scope of this paper.

[4] At the time that the IAA received its terms of reference from the IAIS, the IAIS used the term "best estimate" rather than "current estimate." Subsequently, in its Second Liabilities Paper, the IAIS adopted the terminology "current estimate" to refer to the unbiased estimate of future cash flows reflecting the time value of money, defined as "the expected present value of probability weighted cash flows using current assumptions." The RMWG has adopted the use of the term "current estimate" as standard terminology. Note that, in other literature, the term "current estimate" sometimes includes both current estimates and risk margins.

entity's specific accounting policy, even before consideration of the available data.

The following discusses recognition and (primarily) measurement issues associated with current estimates. Many of the observations are also applicable to the measurement of any other component of the liability, including risk margins. The observations are not meant to describe current best practice in the measurement of the current estimate component of the liabilities of insurance contracts, although in some cases observations regarding certain current practices are indicated. Rather, they attempt to describe expected future practice; as such, it should not be taken to represent current best practice or standards nor comments on the IASB Discussion Paper on Insurance Contracts or any IAIS papers.

4.2 All relevant cash flows to be included

The expected financial effect of all relevant contractual rights and obligations, including the expected effects of all contractual options and guarantees, is included in the current estimates in the measurement of the liability of the insurance contracts. Once a contract has been sold, its current estimate would reflect all of the related expected future cash flows after the measurement (report) date on a prospective basis. In addition, all relevant contract features, cash flows and risks would be considered.

For estimates of the probability-weighted cash flows for catastrophes/calamities, consideration would be given to outstanding claims, but also to future catastrophic/calamity risk (e.g., exposure to concentration risk) on currently inforce contracts. For inforce contracts, this differs from approaches previously taken in some jurisdictions where an accumulation of a portion of previously paid premiums would be reported as a liability, which was sometimes referred to as a “catastrophe reserve”.

Although all possible scenarios are considered, it may not be necessary to incorporate all possible scenarios in the measurement, nor to develop probability distributions in all cases, depending on the materiality of the expected financial effect of the scenario under consideration.

Note, however, that for the purposes of some reporting methodologies, a specified subset of these cash flows would be subject to different considerations, as indicated in 4.3. In those cases, a description of the treatment of those relevant cash flows not included would be disclosed. For example, some measurements will be made before or after income tax, or before or after ceded reinsurance, although in both cases often both bases are needed. See Section 7. 7 for treatment of product adaptability elements, such as terminal bonuses, whose total amounts may not be guaranteed.

4.3 Current estimates are consistent with the scope of and context under which the estimation is made

A current estimate of a set of cash flows may be affected by requirements provided by a specified set of reporting principles, standards or guidance. These standards or rules can include guidance with respect to, for example, the types of cash flows to consider in measurement or unit of measurement to apply. Certain financial reporting standards require market-based inputs, when they are relevant and reliable for use in the calculation of a current estimate, or an observed market input (see Section 4.4). Another set of accounting standards may require certain inputs to be based on entity-specific measures.

In addition, before a current estimate is determined, it is important to carefully define or confirm the object or scope of the estimation, i.e., what is being recognized and measured. The measurement would include all expected cash flows relating to the recognized item, except where a financial reporting requirement specifies otherwise. An example of such an exception is the calculation of current estimates that often excludes associated income taxes, as they are recognized in separate calculations. Since all contractual rights and obligations are reflected, if the obligation is based on a specified set of assets those assets could affect the current estimate of future cash flows in a certain financial reporting structure.

4.3.1 Influence of applicable financial reporting standards and guidance

In certain cases, financial reporting standards or guidance limit the cash flows that can be included in the measurement of the liabilities for an insurance contract. These standards can affect the measurement of the present value of relevant cash flows and can override what would have otherwise been selected as being characteristics of the measurement of cash flows. In some cases, different standards applicable for general purpose and regulatory reporting may call for different assumptions.

These standards and resulting constraints might include one or more of the following:

- The measurement objective under which the estimate is made might be based on the expected settlement of the obligation, its transfer value or its "fair value," although in practice there may sometimes be little practical difference between these amounts.
- The current estimate may not include all related expected cash flows. This may in part be due to what a financial reporting standard would recognize as an asset (e.g., due to lack of control by the entity) or a liability (e.g., due to lack of a present obligation). For example, certain expected cash flows might not be able to be recognized because the insurer does not control them or because they relate to a customer or agent relationship rather than to the contract's rights and obligations, such as certain future renewal premiums that

are not required to be paid under the contracts or after voluntary annuitization.

- Alternative approaches to discounting currently exist. In some accounting systems, the financial reporting standard requires the use of risk-free rates, while others use the expected investment earnings rate of a designated set of assets. Some do not permit discounting, although both the IAIS and the IASB are expected to require discounting wherever it has a significant effect.
- The measurement of a current estimate might not recognize income tax directly derived from the cash flows resulting from the insurance contracts.
- Some aspects of the calculation of a liability might be fixed at the time of the issue of the contract (or be "locked-in") unless an impairment exists. However, both the IASB and the IAIS are expected to require a current measurement, consistent with the most recent available information and expectations.
- Different units of account (see Section 4.5) might be used.
- The expected cash flows of a contract developed by application of a required liability adequacy test might be substituted for the current estimate of the cash flows in certain circumstances.
- A cash value floor or prohibition of negative liabilities might be imposed.
- A limitation of profits recognized at the outset of a contract might be introduced to require that the insurer not recognize profit at the time of issue (see Section 8.2).
- Changes in expected cash flows resulting from certain events expected to occur after the measurement date may not be permitted to be considered in measurement. An example is the expected effect of a future change in law or tax; if these are not to be considered, the measurement is considered based on current law and regulation.

4.4 Market and non-market inputs

Measurement standards can refer to reliance on market-based inputs. For example, fair value standards require inputs to be reliable and be derived from prices that are derived from relevant markets; in this case inputs from other sources or models are used only in the absence of such market observations. For the large majority of contracts offered by insurers, market-based input is either not available or available only for certain measurement assumptions, normally restricted to financial assumptions.

In some cases, there is no reliable source of measurement inputs other than from prices in a market, while in others there is no reliable market on which to base assumptions. In some circumstances, the relevant financial reporting standards may have to be looked to for guidance in the selection of inputs and calibration sources.

4.4.1 Where pertinent and reliable information is available from a relevant market, measurement inputs[5] reflect observed prices or related information

In some cases, financial reporting standards provide rules or guidance regarding which market should be used for observation of prices or related information and any constraints or adjustments that should be applied in using such information. For example, a standard might require the use of risk-free interest rates from an active market.

Some financial reporting systems, when different inputs (assumptions) might use different bases, establish hierarchies regarding what basis of measurement the item uses. In some cases with current estimates, relevant and reliable market-based inputs are used rather than entity-specific based assumptions. This means that information about cash flows relevant to the risk characteristics of those cash flows would be distinguished from inputs that would be based on transaction prices. For insurance contracts, the latter inputs currently relate primarily to financial assumptions and would be generally accepted for this purpose.

4.4.2 When pertinent and reliable information is not available from a relevant market

In the absence of relevant and reliable transaction information from an appropriate market, a valuation technique or model is used to estimate inputs based on non-market based inputs, reflecting portfolio-specific information regarding the underlying risk characteristics of the portfolio. However, if reliable portfolio-specific information for such a technique or model is not available or sufficient, such as often the case of a new line of business, similar relevant entity or industry experience can be used.

This approach is used in pricing a portfolio, augmented where necessary by professional judgment. For instance, although industry or population mortality experience can be used as a basis for a non-market based mortality rate assumption, the observed experience of the portfolio usually provides more relevant information. However, while portfolio mortality experience is more relevant to the development of mortality rate assumptions, it may not be sufficiently credible (i.e., based on a sufficiently large body of data) to stand on its own. In such a case, another source of non-market based information (that is adjusted to be relevant to the portfolio whose liability is being measured) may complement the portfolio mortality experience. Such a source might be industry experience that is gained from a public data source, rather than from a market.

In some cases, observable price information might be available from sources such as third party administrators (e.g., for claim management costs) or from securitizations, reinsurers or business combinations. However, in most such

[5] "inputs" are sometimes referred to as "assumptions"

cases, prices currently available may not relate particularly well to the characteristics of the risks being measured. This may arise from such factors as the need to adjust for events that are unlikely to reoccur (called "one-off events") or the inability to make unbiased adjustments that reflect the individual mix of business, volume of the business, types of claims involved, or new business. In such cases, the appropriateness of the information available needs to be considered prior to its use.

The following criteria or characteristics may be useful in determining non-market based inputs to the development of a current estimate:

- reflect the characteristics of the underlying portfolio for which the current estimate is made,
- be comprehensive,
- reflect all reasonably possible, relevant and foreseeable cash flows related to the market input; i.e., in cases of assumptions in which optionality or guarantees are involved, representative or stochastically generated relevant scenarios are considered,
- reflect policyholder behavior, e.g., voluntary contract termination, where appropriate,
- reflect producer behavior, reflecting expected producer contract terminations where the producer's commission is not vested,
- reflect insurer behavior, to the extent that non-guaranteed elements can be enhanced or dividends that are not determined on the basis of a specified percentage of accumulated surplus,
- are recognized by the financial reporting system,
- be internally consistent with other measurement inputs and the measurement approach used,
- be internally consistent between current estimate and risk margin calculations,
- be representative of expected experience of the portfolio,
- be explicitly determined, and
- be supportable or verifiable, depending on the reporting requirements, with the basis for the inputs being documented to the extent needed.

Financial reporting systems differ with respect to their guidance as to how to handle the unusual situation of a portfolio of insurance contracts for which it is not possible to develop a reliable estimate. For these cases, possible approaches include a requirement to describe the possible impact in disclosure or notes to the financial report or to provide rules to handle a type of situation, such as a liquidity crisis or a run-on-the-bank.

4.5 Non-market based assumptions should be determined on a portfolio-specific basis

Assumptions relate to the specific portfolio of contracts involved and the characteristics of the obligations involved. Therefore, the preferred source of assumptions is experience observations derived from the portfolio to be

measured, to the extent that they are reliable and relevant to the expected future conditions. Adjustments might be needed to reflect expected changes in future conditions or to account for the inadequacy of available experience data of the portfolio.

For most insurance contracts, the use of a contract as the source of observable information would not be reliable. For example, if a single contract were used as the unit of account, both a large expense assumption would result and process risk (i.e., statistical deviation and volatility of experience due to the size of the portfolio, discussed in Section 7.2) would be fully reflected in measurement. In fact in the case of term life insurance when the contract is inforce, no claim experience has occurred from which to assess the contract's future experience. On the other extreme, an industry-wide or even entity-wide basis would not be used except to the extent that it is relevant, as the resulting assumptions would often not be relevant to the exposures, risks and obligations to which the portfolio is exposed. As a result, we conclude that the portfolio is the most relevant source of experience information to use and is the most appropriate unit of account to use, as long as it is relevant and its observable experience is reliable for the purpose.

The historical experience of the specific portfolio or even similar risks of the entity may not be of adequate size to produce credible relevant experience ("credibility", as used in actuarial literature, usually refers to the extent to which the information can be relied upon, while "reliability", as used in accounting literature, usually refers to the extent to which information from the aggregation of homogeneous experience is measurable).

When credible, the portfolio-specific experience data is generally considered more relevant than that from the industry (or the general population). This is because portfolio-specific data is based on the business being valued and already includes measures of its risk characteristics, coverage and insured mix reflecting the underwriting selection performed, claim management, etc. However, when fully credible portfolio-specific data is not available, industry (or general population) experience data can also be useful, although adjustments are often appropriate to reflect differences in risk characteristics (possibly as a supplement or validation of the assumptions made) or in the case of a new line of business. The volume of experience depends not only on the number or amount of relevant insurance risks, but also the length of the period from which experience is observable. Often there is a trade-off between using more data, which would result in using older data that need more adjustment, and using less data that is more reflective of current conditions, but might not be as credible.

4.5.1 What is a portfolio and why is it important

The essence of insurance is the aggregation of homogeneous risks, a transfer from the individual to a large pool. The pooling of risks allows the insurer to manage these risks. Each insurer may have a different objective or approach to

spreading the risk, as the risk transfer is also defined by the marketing and underwriting approach (selection) the insurer applies. Hence, the determination of the level of aggregation of contracts into a relevant portfolio is based on the facts and circumstances involved, since the grouping can be made in more than one way. Given the nature of the business, it is necessary to consider the portfolio of homogenous risks as the unit of account, rather than a single contract or several sets of portfolios. Nevertheless, through the use of one or more risk management approaches (see Chapter 7 for a description of some of these techniques), it is possible to combine portfolios for an insurer.

The relevance of grouping risks into pools is, in part, not only to the effect of pooling on the risk margin, but also to avoid the otherwise inaccuracies of not reflecting any economies of scale on expense levels included in the measurement of the liability. It would be inaccurate because the market expects the use of expense aggregation and use of economies of scale. Consistent with these reasons, IFRS 4.18 indicates that a portfolio is an aggregation of contracts that are subject to broadly similar risks that are managed together.

Although a mono-line insurer might include its entire business as one portfolio, in most entities relevant portfolios would constitute subsets of the business. Even in the mono-line case, different portfolios may exist reflecting the use of such factors as different marketing channels or segments. It is not just the type of insurance exposures involved that is important in selecting relevant portfolios. For example, private passenger automobile and commercial auto may constitute separate portfolios although they are subject to the same types of claim risk. In this case, the method of management of the exposures can also be among the important factors to consider. The relevant concepts that contribute to the determination of the portfolio are the characteristics and management of the insurance contracts.

The use of a portfolio-specific measure (even if the entity consists of multiple non-homogeneous portfolios) is usually more relevant than use of an entire entity. The liability measurement will generally be related to the portfolio's characteristics rather than those of the entire entity. These characteristics include risk and product mix, contract terms, insurance risk characteristics reflected in their underwriting criteria, as well as the entity's processing and data systems used to manage the portfolio and its claim adjusting policy. In other words, the inputs to the measurement of a liability reflect the relevant risk characteristics of the portfolio and the business model used to obtain and manage the business. Of course, use of an excessively small portfolio may be harmful. For example, a very small portfolio may include huge variations in experience which may overwhelm the real level and trend of the underlying experience.

Nevertheless, certain practical issues can result in a portfolio's value to vary depending on the entity that holds it. In particular, this might include the operating expense assumptions. Due to the uniqueness of most insurance

portfolios and differences between the strategy, efficiency of management methods and administrative systems, in practice, portfolio experience and expectations regarding servicing costs will usually depend on the entity that will manage it.

Because the uncertainty of the expected cash flows of the portfolio and other effects of the selection of a portfolio affects the risk margin rather than the current estimate, this subject is not discussed further in this section and is dealt with in Chapter 6.

In addition, the size of the portfolio can affect the extent that economies of scale are reflected in the expense assumption. If the financial reporting standard under which the current estimates are developed recognizes the hypothetical portfolio of relevant market participants, significant economies of scale can be reflected, possibly larger than that evident for the size of the actual portfolio being evaluated.

4.6 Current estimates and current conditions

The assumptions used to derive a current estimate reflect the current expectation based on all currently available information about the relevant cash flows associated with the measurement of the liability. These expectations involve expected probabilities and conditions (scenarios) during the period in which the cash flows are expected to occur. An assessment of expected future conditions is made rather than simply applying recent historical or current experience. Although historical or current experience is often the best source from which current expectations of future experience can be derived for a particular portfolio, current estimates of cash flows would not automatically assume a reproduction of recent experience.

In addition, although the observed experience might be relevant to the portfolio as it existed during the observation period, the current portfolio for which estimates are being made may differ in several respects – in many cases, it could be argued that the current portfolio is usually different from the observed portfolio.

While in some cases recent historical and expected future experience will be identical, in others they will differ, possibly by a significant amount. For example, a change in national macro-economic policy on the day of the valuation might impact the characteristics of current conditions, but would not be reflected in historical experience without adjustment. In many insurance lines, particularly in many general insurance lines, it is appropriate to provide an allowance for possible low frequency, high severity events. If, for example, long-term historical data suggests that an earthquake measuring 8.5 on the Richter scale occurs once in two hundred years in a particular area, this risk will be either over- or under-represented in the experience of the most recent ten years.

Several examples of expected changes in condition need to be explored. An expected change in law or regulation is usually not anticipated, although it may depend on the applicable accounting standard. In contrast, expected changes in most other future conditions are appropriate to be considered in measuring liabilities for a set of insurance contracts. A recent medical breakthrough and a threat of a global epidemic are examples of situations in which current conditions or expectations will not have been reflected in recent experience, but may affect future expectations if a reliable estimate can be made as to their effect on the estimates involved. The decision as to the extent that current conditions should be directly reflected or only used as a consideration to the estimation process can vary by type of assumption (e.g., expense reduction effort or impending law change with possibly voluntary termination effects).

4.7 Consistency of assumptions

If two or more current explicitly determined assumptions are related, i.e., they are either positively or negatively correlated, the basis for the assumptions will be reflected in current estimates in a consistent manner. For example, mortality experience can be affected by contract continuance rates. When the best mortality risks are able to buy other contracts with lower premiums so that increased discontinuance leads to anti-selection, a higher mortality assumption is appropriate. Another example would be that policyholder behavior expectation may be linked to interest rate scenarios.

If financial reporting guidance restricts the use of some assumptions, inherent difficulties in developing estimates of the interrelationships between assumptions can be created. For example, a financial reporting system may not permit a contract liability to be recorded at less than its cash surrender value, may not recognize non-guaranteed elements, or may be based on a rational expectations model (i.e., the worst case scenario within a probable range of outcomes) irrespective of whether current market observations indicate that those who pay premiums do not act consistently with those assumptions. The result of such constraints would be an unrealistic current estimate that does not reflect the combination of all relevant and reliable assumptions.

In some cases, the cash flows of a given period depend significantly on the outcome of prior cash flows, while in others they are independent of them. The former might include the use of an assumption regarding the mean reversion in certain types of cash flows such as returns on equity. Such an assumption needs to be validated at each measurement date. This would be done by means of using observable historical results to help ensure that such a mean reversion assumption faithfully represents the current estimate of expected future cash flows. This type of assumption may not necessarily be market consistent at a current point in time. Another example is the use of contract discontinuance rate assumptions in which experience under similar current or expected economic and competitive conditions may not be available.

The issue of consistency of assumptions over time is important, relating to the extent of responsiveness to reported changes in experience. In general, it is preferable to revisit assumptions on a regular basis, and to avoid waiting for a large catch-up change. Actuarial credibility can provide a theoretical basis for adjusting assumptions to the extent justified by the latest relevant experience. This helps to avoid large offsetting changes in successive periods. See Section 4.1.11 for a more in-depth discussion.

Also, the discount rates for each future period and the distribution of cash flows over the period covered may not be independent. In such a case, the combined effect of the discount rate applied at each duration and the expected cash flow pattern may need special attention.

4.8 Determination of the valuation technique (methodology) and considerations regarding its inputs

Once the valuation approach to the assumption (e.g., market-based or non-market-based) is selected, the input parameters (assumptions) are derived. Note that in certain cases, the use of inputs from multiple valuation techniques can enhance the reasonableness of the current estimates. Depending on the portfolio whose current value is being measured, valuation assumptions for the approach selected can include the incidence, severity, claim development and timing of claim settlement, mortality, morbidity, policyholder behavior, expenses, and investment returns or discount rates, and their interaction.

Assumptions are applied on the basis of the given method, often determined by use of one or more actuarial models. For each valuation technique applied, each significant assumption is assessed independently and incorporated as an input to the valuation. The effect of other assumptions (e.g., the effect of interest rates in a scenario on discontinuance rates) is also reflected. Although the assumptions need to be reasonable in the aggregate, each significant assumption made is also assessed individually. To the extent practical, each assumption would be explicitly estimated rather than implicitly considered. In certain cases, the implementation of such an approach may prove impractical.

As a unique process and method may not exist to derive assumptions, professional judgment is often needed. The judgment would be assessed for relevance and reliability. In some cases, an assumption that may apply to one portfolio might not be appropriate for another. In other cases, there may be so many assumptions involved, it would be difficult to isolate a specific assumption. For example, certain assumptions that might provide separate inputs to the estimation of certain cash flows may be difficult to isolate, such as in a separate hypothetical analysis of the frequency and severity of claims if claim counts are not available. In such a case, the use of their combined effect would be used, as their combination would be more reliable, or it may be more credible to directly estimate the total losses or benefits rather than to derive separate distribution

functions of the number and size of the claims or benefits and then to combine them.

The available data can impact the complexity of the model or models selected for use. The availability of only a few data points may only allow for a simple model to be developed and applied. If an overly complex model is applied in a case in which there is limited data, an impression will be given that unwarranted precision is used that cannot be supported. In addition, when there has been a short time since a major change in conditions emerged, a realistic trend analysis might be limited. As more detailed data becomes available, this may be less important.

4.9 Asymmetry of expected losses or benefits

Expected cash flows can be influenced by the following factors:

- non-uniform or asymmetric probability distributions
- a contractual option used by policyholders in a way that benefits them
- asymmetric severity, reflecting limits on the distribution of claims or policy size.

Often a non-symmetric probability distribution would be applicable, e.g., as a result of a fat or catastrophic tail or a one-sided limit on possible assumption values such as non-negative mortality rates or voluntary contract terminations. Non-symmetric examples include guarantees (minimum cash value or interest rate credited or maximum cost of insurance charged); limits to values (e.g., reinsurance retention limits or non-negative contract termination assumptions); or asymmetric severity (e.g., many small claims but relatively few total losses). In these cases average values of observations not reflecting the asymmetric effect of such assumptions may not produce a reasonable current estimate. As a result, when it makes a significant difference in the current estimate, the effects of asymmetry would be reflected.

For example, in a case in which optionality or non-symmetric expected cash flows are involved, the use of a stochastic method with asymmetric distributions may be appropriate. Alternatively, sufficiently validated representative deterministic assumptions might produce sufficiently similar results. And it may be more precise to consider the overall range of scenarios by applying an actuarial model using probability functions with similar asymmetry. Note that in the derivation of soundly-based estimates of expected experience, the use of refined or sophisticated methods is not a substitute for a basic understanding of the experience data used and its context, or for an understanding of the range of probable values.

There are several approaches that might be taken in a stochastic analysis. Boundary conditions and asymmetric probability distributions can be considered in any of them. Three of the approaches to stochastic path analysis are:

1. *General stochastics* typically refer to a number of stochastic paths generated from the initial point in time.

2. *A nested stochastic approach* is one in which stochastic scenarios are generated at each future point in time during a projection period. A simple decision tree diagram can be used to illustrate the results. If there are three potential outcomes during each period, then at the end of period 1 there are 3 possible states. At the end of period 2 there are 9 (3x3) possible states and at the end of period "n" there are 3 to the nth power possible states.

3. *A second nested stochastic approach* uses a deterministic rule to decide how to select from the stochastically generated period results, followed by new sets of stochastically generated period results for each of the succeeding periods. In this manner the number of possible states at any point along the path from our previous example is 3. This illustrates the benefit of reducing the number of calculations as the projection period lengthens or the number of stochastic scenarios increases. But the decision-rule must be determined in advance (possibly the median stochastically generated period results are selected for each succeeding point).

4.10 Approximations

Approximations can sometimes be made to individual assumptions or to aggregate estimates so that they can be developed in a relatively simplified manner and yet still produce reasonable estimates in compliance with a financial reporting system. For instance, approximations are often used for one or more assumptions in connection with particular types of contracts if the current estimate for those contracts is not sensitive to variations in those assumptions. Approximations are usually made for practical reasons, but nevertheless they would be performed in a technically sound manner applied to a financial reporting standard. For example, in many cases a mid-year assumption for cash flows represents a sufficiently accurate estimate for the purpose of estimating the timing of future annual cash flows, and the average age in a quinquennial age grouping may be appropriate in many situations. Nevertheless, such simplifications may not always be appropriate, depending on the facts and circumstances involved.

The extent of grouping of risk classes in current estimates for a portfolio or contract can be a function of the amount, type and reliability of portfolio- or product-specific experience and can be impacted by technology restraints. It is not uncommon that as technology is enhanced (usually with more powerful computers or more efficient software), more refined models, e.g., seriatim modeling, is used. The appropriate extent of grouping may be determined on the basis of the homogeneity of the group with respect to applicable risk characteristics and their size.

The number and range of future scenarios to be considered may depend upon the circumstances and the materiality and importance of the calculation. Although in some cases the consideration of more scenarios will result in a more accurate calculation, this will not always be the case. This will occur when the cash flows are not particularly sensitive to the number or range of scenarios considered. In some cases, experience will help determine this sensitivity, while in others trial and error testing may be needed to determine the number and range of scenarios to consider. The most representative, weighted average or best estimate scenario may be sufficient, although in some cases it might be better to test the technique selected rather than simply assume it is sufficient.

Both the IAIS and the IASB have referred to the use of probability-weighted cash flows. These references may be used simply to emphasize that what is desired is the expected value (or mean) of the resulting cash flows, rather than the most likely set (the mode) or the average cash flows (the median). In some cases it may be practical to develop a theoretically derived probability distribution analytically or to derive the mean value by using an explicit experience-based distribution to directly estimate a mean value. Alternatively, suitable calculations may be derived that do not use a complete probability distribution.

If a small entity or unique portfolio is involved, it can be appropriate to use a less-refined model or larger grouping, considering materiality and that relevant data may not be available. In particular, an extensive database of portfolio-specific experience is not likely to be available. Nevertheless, even in this case it is necessary to be convinced that the model and assumptions used are sufficiently reliable and could be used to produce an unbiased current estimate.

For relatively small blocks of business within a larger entity or a small entity that has relatively simple products, practical approaches to measurement are often appropriate. The decisions regarding the acceptability of these approximations have to be made on a case-by-case basis, reflecting the relative significance of the risks involved and their potential sensitivity to the area in which approximations are applied. Periodic testing of continued acceptability of the approximations, including roll-forward methods, may be necessary.

4.11 Quality of data

In some cases, only limited or unreliable data may be available from the insurer's experience of a particular type of product from which to base an assumption for that product. In such cases, other relevant experience sources would be sought. These sources may be derived from similar products, portfolios or markets, from the entity or, if not available, from industry or population sources. If appropriate, adjustments are made to these alternative sources so that they better match the risk characteristics of the portfolio. If the extent of portfolio-specific data is significant but not sufficient to form the entire input for a model, then a credibility approach might be taken that weights the portfolio-specific experience or data with that from other sources. Often actuarial judgment is necessary to determine

the most relevant experience and to derive appropriate adjustments to the most reliable and relevant available source.

The quality and availability of relevant and reliable portfolio-specific data used to determine the level, trend and volatility of assumptions may affect the risk margin, or the uncertainty surrounding the expected values, to a greater extent than they may affect the estimate of the present values of expected cash flows. Nevertheless, the lack of a reliable source can create significant difficulties in deriving a current estimate.

Assumed (inward) reinsurance can present a particular challenge when the data made available by the cedants is limited, of poor quality or late (sometimes by one to several quarters). The problems can relate either to experience or to the amount of business being reinsured, or both. Reinsurers often develop their assumptions based on experience from similar business from other cedants, pricing assumptions or older-than-desirable experience.

If sufficiently relevant and reliable experience and data are not available to derive reasonable estimates, the applicable financial reporting standards or guidance may determine the consequences of an inability to provide a reliable measurement. Particularly with respect to a liability, some commentators believe that any estimate is better than none at all (at least to the extent of a lower bound of an estimate), although certain accounting literature indicates that where no reliable basis exists, no value would be included in the balance sheet, and instead disclosure of the risks and uncertainty involved would be included in disclosure or the notes to the financial report. Conversely, it is possible for a highly uncertain estimate to be reliable if an adequate understanding of the degree of uncertainty can be described. In some regulatory contexts, more prudently selected current assumptions have historically been used.

Situations of interest to actuaries where an expected value cannot be derived are relatively rare. In such cases, the most useful financial information may consist of a minimum liability value if it can be determined in a reliable manner, although it is usually not clear how such a minimum value would be derived.

4.12 Updating assumptions

The following two sections discuss the updating of assumptions, both those based on observed transaction prices in a market and those that are not.

4.12.1 Non-market based assumptions

When using current expectations to derive an estimate of non-market assumptions, the assumptions are reviewed regularly and systematically at each measurement date. While review is needed at each measurement date and at least annually, an update to an assumption may not be needed unless there is significant credible new information to suggest otherwise.

In a financial reporting system that does not permit the application of updated current estimates, but rather requires "locked-in" or non-current assumptions to be applied, current estimates may be required to be updated as a result of a liability adequacy, loss recoverability, or premium deficiency test.

The measurement of the amount of liabilities of insurance contracts is regularly updated when current expectations differ from those incorporated in the prior estimates. Generally a revision is made as of a measurement date when the effect on current estimates from differences between current and prior expectations become material. In assessing the credibility and relevance of the differences, the same general guidance applies as provided in deriving the initial or prior sets of expectations. An update to an estimate may have to be significant before it is required or permitted by particular financial reporting guidance. Usually financial reporting requires that materiality be assessed based on the extent of the impact to the liability being measured, rather than on the amount of change in an individual assumption. Except in the case where the choice of assumption is constrained by an accounting rule (such a lock-in requirement), an update would be permitted if the accounting consequence is not material, although such an update would not be required.

Changes in assumptions may arise for several reasons, including:

- A previous assumption may have been based on poor quality or limited data. The appropriate accounting standard would be applied to determine whether an accounting error existed. Enhanced data or an expanded experience or data source can enhance the accuracy of current estimates, as the enhancement may result from an improvement in understanding of the situation.
- Available experience data previously used may not be actuarially credible because of the limited amount of available experience data or because the experience reflected conditions that are not expected to continue. Note that credibility is a continuum; that is, experience data can sometimes provide some but not all of the assurance needed for an assumption.
- An inappropriate model of future cash flows may have previously been used. For example, it may have been assumed that future cash flows were distributed according to probability distribution A, when it is subsequently determined, based on additional information or changed conditions, that they are more consistent with probability distribution B. Or more knowledge is gained regarding cash flow drivers. Another example is when a factor contributing to an assumption or the interaction between two assumptions may have been observed or was unobservable that it is currently expected to influence future cash flows.
- Estimates of the assumption of an underlying probability distribution may differ from actual experience. For example, a distribution with a mean of 100 and a standard deviation of 10 may have been estimated, but newer

observed data has a mean of 120 and a standard deviation of 15. In this case, changed conditions have superseded prior experience.

Where limited data is available, actuarial credibility can provide a sound basis for combining estimates from different sources of relevant data sources and for updating those estimates as new data becomes available. Typically, some directly relevant data from the contracts are considered, as well as collateral data from a range of other sources, such as similar portfolios. It is often necessary to adjust such collateral data for known or perceived differences from the subject set of contracts, to make it relevant to the estimation. After such adjustment, actuarial credibility can be used to develop a weighted average of the various estimates. Nevertheless, the extent of adjustments made is monitored and considered when setting the risk margin.

Another case is the common assumption that the current law will remain in effect in the future. When there are changes to statute or case law, assumptions are evaluated in the context of the financial reporting system and reviewed periodically.

It is a best practice to document the reason(s) for and effect of adjustments made to an assumption and, in cases where there is some change in experience or other information and assumptions were not changed, the reason why an assumption was not adjusted.

Financial reporting standards often distinguish between errors, changes in accounting estimates and changes in accounting policy. IASP No. 8, *Changes in Accounting Policies under IFRS [2005]* describes such differentiation in more detail. Any changes need to be so categorized, as they are treated differently. However, such a determination usually depends on the facts and circumstances involved. For example, a move from decennial age groupings to quinquennial age groupings or a change in development factors are usually considered to be a change in estimates, while the introduction of a mortality trend or a change from a market-based to a non-market based discount assumption are examples of a 'change in basis' (a term used in some accounting systems to describe a situation in which, for example, a method or fundamental change in approach in measuring an assumption has occurred) or might be considered in some cases to be a change in accounting policy, which might be reported separately in some financial reporting systems.

4.12.2 Market based assumptions

Market-based assumptions are also updated on each measurement date, based on a review of observable transaction prices in a relevant market.

5. Discounting Cash Flows

5.1 Introduction

The objective of applying a discount rate to a future cash flow is to reflect the time value of money in order to place a value on a set of cash flows. Depending upon the objective and context of measurement, the method and measurement used can differ. The most common objective is to assign a value to a particular future cash flow considered in measurement.

Discount rates can be based on whether a contract's obligation is either (1) directly linked to a designated portfolio of assets or contract-specified asset performance or (2) not directly linked. In some cases, this distinction is not clear cut, in that the linkage may only be related in part or where other factors may be involved, such as competitive considerations or regulatory requirements. Most of the remainder of this section is devoted to the obligation type 2; the first type is discussed in Section 5.4.

Current bases for discount rates differ, in some cases dramatically, depending in part on the financial reporting requirements and objectives under which the discounting is being conducted and contract type involved. Discount rate bases used to determine the present value of cash flows might consist of risk-free rates, high quality corporate bond rates, expected entity-specific investment earnings, current or initial credited rates, or imputed interest rates (e.g., in an amortized cost approach). Discount rates may depend on the duration of the cash flow being discounted, i.e., yield curve specific.

The current view of both the IAIS and the IASB is that a liability should be measured independently from the actual assets held by the entity. A practical assumption that may be used is that a transferee would assess the liabilities based on a set of matching assets associated with minimum risk (the replicating portfolio), with an additional margin for the remaining mismatch between the liabilities and corresponding assets.

In cases in which discount rates have limited influence on the liability cash flows of insurance liabilities or where there is a relatively flat yield curve, a single average discount rate may be acceptable, depending on materiality considerations. If used, such an average discount rate would normally be determined so its application results in a liability similar to that obtained by using the complete yield curve and may need to be reviewed on a regular basis to ensure that its effect remains similar to that of the applicable yield curve. The equivalent average rate also can provide a useful benchmark for comparison purposes. Historically, this approach was used in part to minimize the computational burden.

If there are no relevant observable market rates, then the most similar available yield curve or interest rates would usually be used. For example, if there is no

market in which risk-free securities are traded in a jurisdiction from which to observe yield rates at a particular duration, such as would be the case in a jurisdiction where such securities are not available at a duration as long as a duration of a cash flow from an insurance contract, then the closest available securities might be the base from which the estimate would be derived. An adjustment for the difference between the characteristics of those securities and the characteristics of the liabilities would be made. Note that the applicable financial reporting context or standard might provide guidance as to how that adjustment might be made or a completely different approach could be applied.

Several methods can be applied to extend a yield curve for terms beyond the last available rate in the market. The simplest approach is use the last available rate (for example the 20-year rate for a 30-year cash flow). A more advanced method would be to extrapolate the yield curve with a constant slope assuming that the forward rate observed between the last two market rates stays constant. When limited market data is available or when the term of the cash flow is significantly beyond the last available market rate, then a model can be applied to extend the yield curve. One could use a financial model like the Hull-White model or a parity relationship such as real interest rate parity convergence as discussed by Ferreira and Leon-Ledesma [2003].

The extrapolation of yield rates beyond 20 years could also be viewed as constituting an unhedgeable risk that would be considered in determining a risk margin. If done appropriately, either approach would lead to a consistent estimate and would represent a market-consistent basis for discounting purposes.

Expected total investment returns can be a significant factor that can be considered in the measurement of liabilities for insurance contracts, for example, in deriving the cost of certain contract guarantees. However, a discussion of specific models, including those involving future yields on equity instruments, is outside the scope of this paper.

In regard to the application of discount rates in conjunction with stochastic projections, two approaches have been taken. The first is to develop different scenarios with consistent cash flows, discounting them with the applicable yield curve relative to each scenario and weighting the results to determine the mean. The second is to weight the cash flows in each scenario by their probabilities and then apply a single current yield curve. Care is needed to ensure that aggregate market-consistent yield rates are used.

In the application of certain accounting standards, mean-reversion models have sometimes been used, although they are not considered to be market-consistent.

Possible alternative approaches include the use of high quality long-term bond assumptions, deflators (particularly if equity assets are the linked set of assets), or average historical long-term experience. Nevertheless, current accounting

discussions may lead to the use of risk-free discount rates independent of expected total entity investment returns, unless the obligation to policyholders is directly linked to the entity's asset returns.

In the remainder of this section we discuss the following conceptual aspects related to the determination of the discount rates to be used to measure the liabilities of insurance contracts:

- Risk-free rates (Section 5.2)
- The liquidity premium that might be added to the risk-free rates (Section 5.3)
- Linked and related approaches (Section 5.4).

Some view an allowance for non-performance (also referred to as credit characteristics of the obligation or 'own credit standing') to be associated with the discount rates. As it is not necessarily related to discount rates, it is discussed in Section 8.3.

5.2 Risk-free discount rates

The following alternative approaches to measuring a set of risk-free rates are considered in this section

- Government bond rates
- Government bond rates plus an adjustment
- Corporate bond rates minus an adjustment
- Swap rates minus adjustment
- Swap rates.

It is important to note that risk-free in this context refers to being free from default, yet generally other risks, such as market, inflation and sovereign risk are still included.

5.2.1 Government bond rates

Government bond yields of the jurisdiction of the entity are often considered to be the closest to risk-free that can be measured from market transactions and, from a practical perspective, is often the only measure that is directly observable without needing further adjustment.

The disadvantages of a currently tradable Government bond yield measure include:

- A limited number of outstanding terms for long-dated Government bonds may provide only a few observable points from which to base the long-end of the yield curve.

- Government bond prices can be distorted due to an artificially high demand from financial institutions and pension funds that may be subject to regulatory constraints that favor Government bond holdings or were the basis at the time issued of a benchmark (e.g., a ten-year bond whose yield might be 50 basis points greater than either a nine- or eleven-year bond). These supply and demand distortions may not be considered to be relevant for the cash flows expected to occur at that duration.

- There may not be a liquid government bond market, particularly in those jurisdictions in which the government has run a surplus or in a jurisdiction with limited capital markets.

The most straightforward way to measure a government bond yield is to observe prices of a zero-coupon bond. However, prices for such a bond may not be available for a particular duration. To the extent dividends are payable, if a call option is included or if a constraint is placed on the bond or the market, applicable adjustments may be able to be made to determine the price/yield corresponding to a zero-coupon basis.

5.2.2 Government bond rates plus adjustment

The rationale put forth for adjusting Government bond yields is that in some cases it is desirable to eliminate market distortions that may not be relevant to the expected cash flows that are a part of the liability for insurance contracts. Such an adjustment might still be considered as being based on prices.

A common distortion is the short supply of Government bonds at the long end of the yield curve. However, it is very difficult to quantify and to make an adjustment for this effect. In fact, an example of an investment strategy that failed due to this lack of supply was Long Term Capital Management.

Another distortion in some markets is the ability of Government bonds to be used in general collateral ("GC") repurchase (repo) transactions, which allow the holder of the Government bond to earn an extra premium over the Government bond yield. In the UK, the Bank of England has described GC repurchase transactions as follows:

> "Government bond sale and repurchase ("Government bond repo") transactions involve the temporary exchange of cash and Government bonds between two parties; they are a means of short-term borrowing using Government bonds as collateral. The lender of funds holds government bonds as collateral, so is protected in the event of default by the borrower. General collateral (GC) repo rates refer to the rates for

> repurchase agreements in which any Government bond stock may be used as collateral. Hence GC repo rates should, in principle, be close to true risk-free rates. Repo contracts are actively traded for maturities out to one year; the rates prevailing on these contracts are very similar to the yields on comparable-maturity conventional Government bonds."

In efficient markets the ability to earn an extra premium will be reflected in corresponding lower Government bond yields. The repo-ability of Government bonds is clearly not relevant to liability valuation, so this premium can be added back to the Government bond yield when valuing the liability.

This view is also expressed in the UK Board for Actuarial Standards Actuarial Guidance Note 45, paragraph 4.1.3, when developing a "realistic" balance sheet. An earlier version of this guidance note based on a 2004 analysis suggested that repo rates exceed Government bond yields of equivalent term by around 5-10 basis points.

In the UK, although the Financial Services Authority (FSA) has not formally provided an opinion regarding risk-free rates, it has referred to generally accepted actuarial practice. In practice, it has not objected to the use of 'Government bonds plus' to eliminate the effect of market distortions, or in the context of annuities to entities adding further liquidity spreads to their valuation rates.

In jurisdictions where the repo–Government bond spread is readily observable, entities should be able to perform a regular analysis of the GC repo curve.

While this might eliminate an important distortion, the Government bond yield plus measure may often be conservative or prudent due to other non-quantifiable market distortions. However, it may suffer the general disadvantages of any Government bond measure in terms of robustness at the long end of the yield curve and a relatively illiquid government bond market in some jurisdictions.

5.2.3 Corporate bond rates minus adjustment

Corporate bond rates minus an adjustment is an alternative to a 'Government bonds plus' basis. It starts with high-quality, low-risk corporate bond rates and deducts a margin for default risk (and perhaps other elements not relevant to the insurance obligation), to arrive at a proxy for risk-free rates. This approach avoids having to eliminate distortions to Government bond yields, especially if a robust corporate bond market exists in the jurisdiction.

Expected defaults are typically based on well-known studies of historic default data. For example, Table 5.1 was developed from Merrill Lynch data for the U.S. market (1997-2003). It shows both the market credit spread and the spread based on expected defaults. Note that the relative difference between the two decreases as the credit rating gets worse and debt gets longer.

Table 5.1 U.S. corporate bond credit spreads

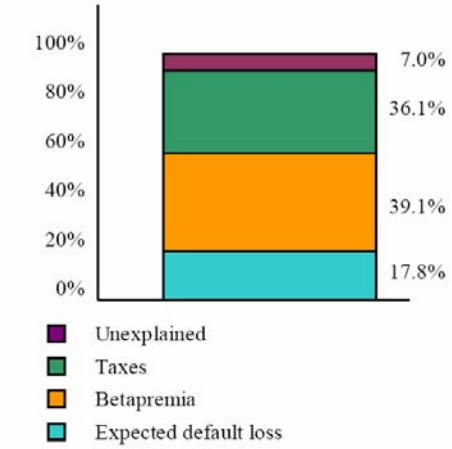
	=> => Increasing term to maturity => =>							
Rating	**Spread**	**Expected loss**	**Spread**	**Expected loss**	**Spread**	**Expected loss**	**Spread**	**Expected loss**
AAA	49.50	0.06	63.86	0.18	70.47	0.33	73.95	0.61
AA	58.97	1.24	71.22	1.44	82.36	1.86	88.57	2.70
A	88.82	1.12	102.91	2.78	110.71	4.71	117.52	7.32
BBB	168.99	12.48	170.89	20.12	185.34	27.17	179.63	34.56
BB	421.20	103.09	364.55	126.74	345.37	140.52	322.32	148.05
B	760.84	426.16	691.81	400.52	571.94	368.38	512.43	329.40

Values in basis points

The difference between the market spread and the expected default loss consists of both expected credit losses and the effect of uncertainty associated with these losses. If the credit spread on high quality corporate bonds only compensated for expected defaults, then it would be more attractive to hold Government bonds than corporate bonds, since Government bonds would offer the same expected return for less risk.

In fact, the overall credit spread of corporate bonds is composed of a number of elements which are shown in the figure below.

Figure 5.2 Estimated relative contribution of different elements of the spread between A rated bonds and U.S. Treasuries



Source: Credit Derivatives, Derivatives working party (2005)

The Beta premia is also known as the credit risk premium. It is reasonable to assume that a credit risk premium exists that compensates the investor for the uncertainty associated with actual defaults being different from expected. Credit risk is also positively correlated with equity risk and, more generally, with overall

drivers of market risk. Hence, this cannot be diversified away and should command a risk premium.

The tax element shown in Figure 5.2 may be specific for the U.S. and not apply in other markets. It relates to a differential tax treatment of returns on government bonds and corporate bonds.

The unexplained element in Figure 5.2 could relate to a number of possible smaller elements including:

- Small sample bias – the market might require an allowance for more extreme events than are observed from historical data.
- Skewed nature of payoff – investors requiring additional compensation for the skewed risk profile, i.e., capped upside and heavy downside.
- Correlation effects with interest rates – the required credit spread might be reduced due to negative correlation between credit spreads and interest rates.

An additional important element of the spread which was not analyzed in the Merrill Lynch study underlying the above figures is the liquidity premium (see Section 5.3).

To the extent that any of these credit spread elements are not reflected in the insurance obligations, they need to be quantified and deducted from the corporate bond yields in addition to the expected defaults to derive the appropriate discount rates.

In practice, it may be difficult, if not impossible, to quantify these elements in a robust manner. This measure may be the least robust of all the potential risk-free rate measures discussed in this paper.

The IASB staff has pointed out a similar caveat regarding robustness, but also points to a possible advantage of this approach. Since corporate bonds are usually less liquid then Government bonds, if it is desirable to include a liquidity premium, this approach will, at least in theory provide a less liquid risk-free rate.

> Some have suggested starting with a high-quality corporate bond rate and deducting a premium for defaults. (That premium would need to capture both expected defaults and the premium for bearing the risk that defaults exceed expectations). The aim would be to arrive at a discount rate reflecting the pure time value of money without a liquidity premium. In the staff's view, that approach might conceivably be appropriate, if the default premium can be estimated reliably and if it is possible to be confident that the bond rate does not include some other factor that is not relevant to the liability. (IASB Agenda paper 7G Discount rates, March 2006)

5.2.4 Swap rates minus adjustment

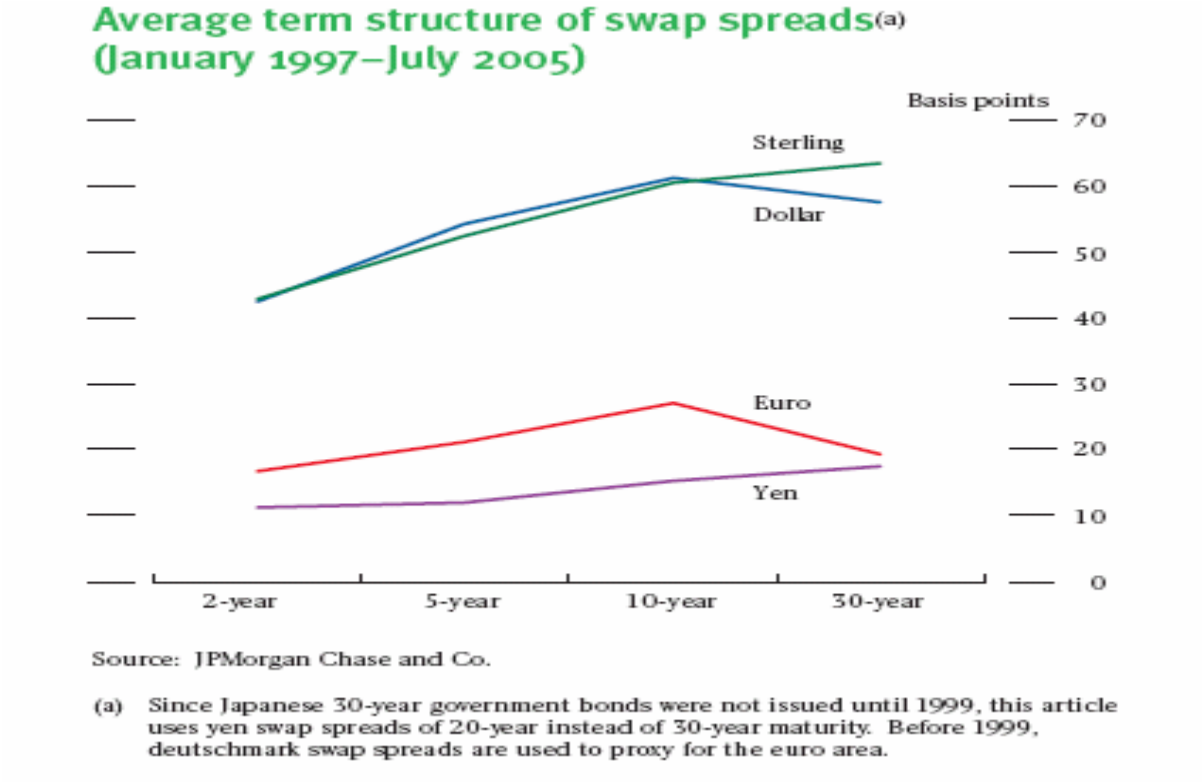
Given the disadvantages of starting with corporate bond rates, a more promising alternative may be the use of swaps as a basis for the risk-free rate. The following definition is from the Bank of England.

> An interest rate swap contract is an agreement between two counterparties to exchange fixed interest-rate payments for floating interest rate payments, based on a pre-determined notional principal, at the start of each of a number of successive periods. The floating interest rate chosen to settle against the pre-agreed fixed swap rate is determined by the counterparties in advance. There are two such floating rates used in the sterling swap markets: the sterling overnight interest rate average (SONIA) and the six-month Libor. Libor swaps settle against six-month Libor rates. Swaps are typically used by financial institutions to help reduce their funding costs, to improve the match between their liabilities and their assets, and to hedge long positions in the cash markets. Traded swap contract maturities range from 2 years to 50 years.

Note that long durations may not be available in many jurisdictions; in fact, in less-developed markets swaps only trade up to 10 years, while even in many developed markets, swaps do not extend beyond 30 years. In some jurisdictions, the swap market is more liquid than the Government bond market, but its main advantage is that this liquidity often extends a lot further than the Government bond market and may, therefore, represent a more robust and reliable basis for determining discount rates for long-term insurance obligations.

Figure 5.3 shows average historic swaps spreads over government bond yields.

Figure 5.3 Average term structure of swap spreads (January 1997-July 2005)



In developed markets swap spreads over government bond yields are typically positive. For countries where government bond markets are less developed and therefore less liquid or where governments have low credit ratings, negative spreads can be observed.

Swaps are over-the-counter (OTC) contracts, primarily transacted between counterparties who are both financial institutions. Swaps do not reflect the credit risk of the parties transacting the swap. Instead, the credit risk of swaps refers to the credit risk inherent in achieving the floating leg of the swap. The credit risk inherent in the floating leg will equally be reflected in the fixed leg of the swap and would be adjusted for in any measure for risk-free rates.

Another element of the swap spread to be deducted from the swap rate is the fact that in practice there are no deposit instruments that earn the six-month London Interbank Offered Rate (LIBOR).

A majority of the swap market is usually either collateralized or operates through margin accounts. Where this is the case, risk of non-payment is reduced, but the cost of the collateral or maintenance of the margin account would be reflected as well.

The highest risk-free returns that could be achieved on the floating leg would be the GC repo rate. To earn the GC repo rate, the floating leg would have to be invested in a Government bond, followed by entry into a repo agreement with this Government bond as collateral.

Naturally this means the entity would suffer a loss between the LIBOR rate that is due on the swap and the GC repo rate that is earned. However, its position would be risk-free. This loss could therefore be seen as an allowance for default risk and corresponding credit risk premium.

A practical approach to arrive at a swap-based risk-free rate is therefore to deduct from swap rates this spread between LIBOR and the aforementioned GC repo rates.

Figure 5.4 shows the Government bond (Zero Gilt), LIBOR and GC repo rates in the UK at the end of 2005 over a one year time horizon.

Figure 5.4 Libor Rates vs repo rates

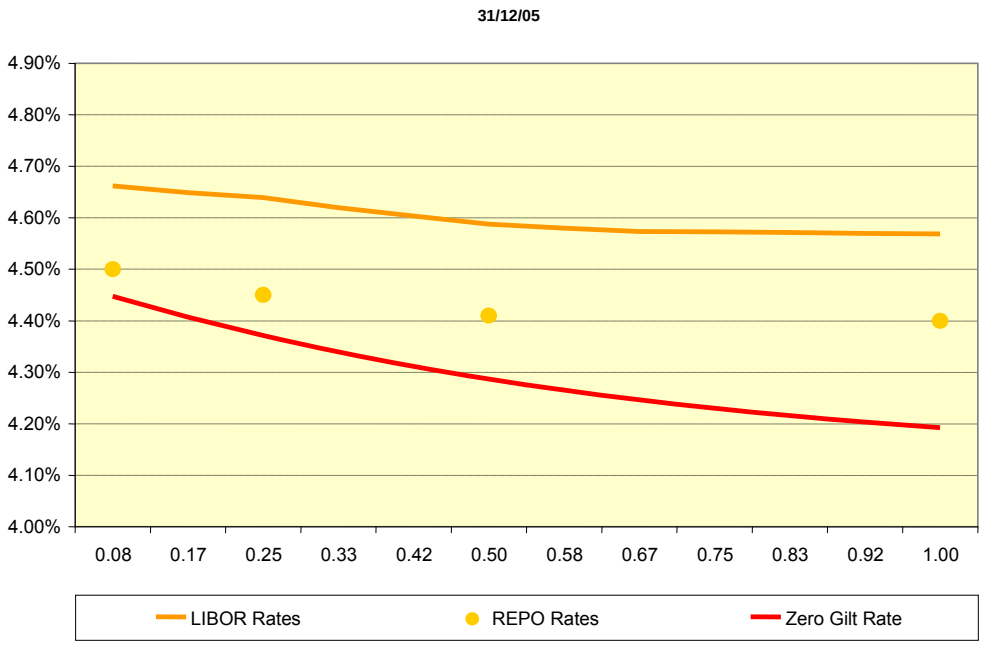


Figure 5.4 shows that, for the relevant six-month LIBOR term, the spread of LIBOR over the GC repo rate is around 20bp.

Recent swap spreads over Government bonds have generally been around 30bp (with a maturity of 10 years). This would imply a spread over Government bonds of around 10bps. Note that the spread size differs significantly by jurisdiction. Furthermore, spreads can increase significantly in periods of market turbulence when a flight into risk-free and liquid assets is observed such as in late 2007 when U.K. spreads widened to 70bp (with a maturity of 5 years).

The Bank of England supports the approach of 'swaps minus' as a reasonable way to determine the true risk-free rate (see for example, Bank of England (2005)).

5.2.5 Swap rates

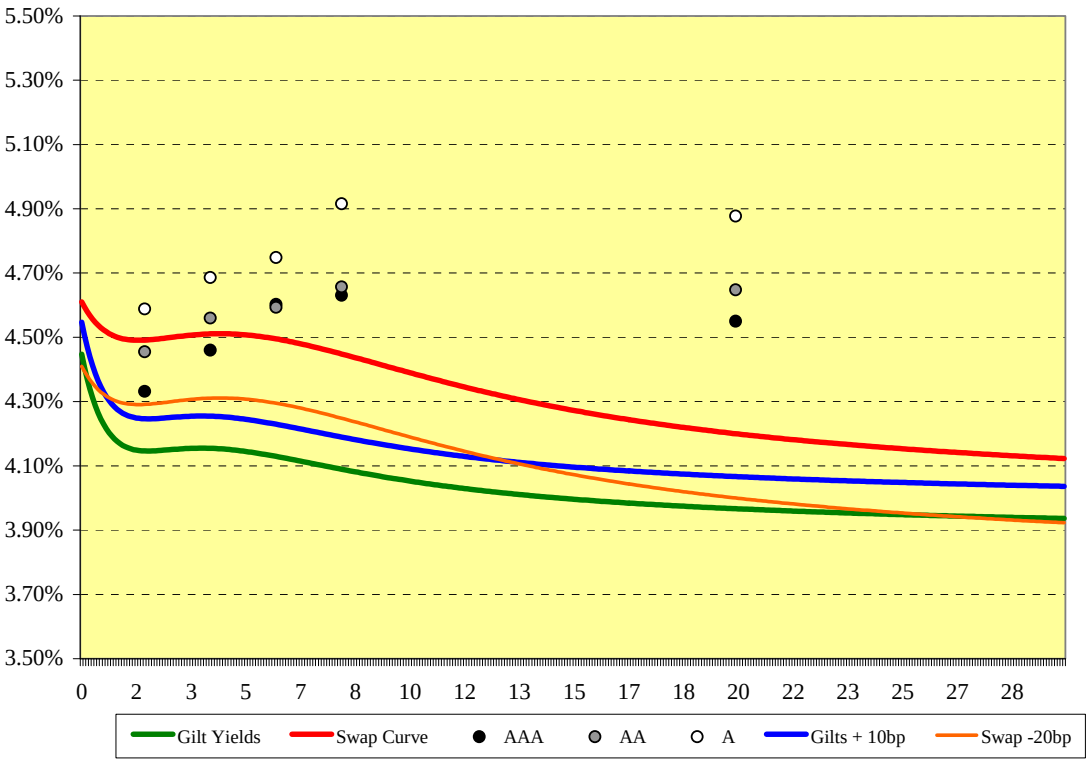
Given the above, it may be difficult to justify unadjusted swap spreads as risk-free. Nevertheless, the Chief Risk Officer (CRO) Forum has presented this benchmark by indicating that "they are typically the most liquid, complete and reliable risk-free rates available. This is more conservative than using a truly economic discount rate that would include an allowance for the credit spread of the insurer itself (or of the counterparty to whom the liabilities would be transferred in the event of insolvency)".

The above argument may not be sustainable, in that it mixes the issues of basic risk-free rates and the credit characteristics of insurance liabilities.

5.2.6 Comparison

Figure 5.5 shows a comparison between the various possible measures discussed above, as at end 2005 over a 30 year term (note that in these graphs gilts refer to Government bonds).

Figure 5.5 Possible bases for discounting



5.3 Liquidity

5.3.1 The liquidity premium

The risk-free rates discussed so far are those that can be earned on highly liquid assets such as government bonds and swaps. To the extent that the cash flows considered in the liabilities are less liquid than these assets, it might be appropriate to use a different set of discount rates to reflect this characteristic (as the replicating portfolio for the cash flows does not need to be as liquid).

Liquidity, as a term, has been used to represent many things -- in this section it refers to the extent to which an asset or liability can be converted to cash or a cash equivalent as desired. It is more commonly applied as a characteristic of an asset. As a result, neither literature nor practice has developed for an independent application of this concept to liabilities.

It is not sufficient to discuss liquidity from the perspective of an asset, as the view of the liability is more relevant for the purpose of this paper. In other words, the simple fact that there is a liquidity premium observable in asset prices may not be sufficient to indicate that a provision for reflecting liquidity premiums in the measurement of a liability for insurance contracts is appropriate. If a liquidity premium is included in the calculation of a liability, then its estimation becomes relevant. The extent of its relevance may depend on the extent that liquidity is important to potential transferees or market participants.

If it is decided that liquidity should be considered in the measurement of liabilities of insurance contracts, the question then moves to how it should be considered. If the measurement considers scenarios of deterministically-determined cash flows, discounting could be on an entirely non-liquid basis, since the liquidity premium results from weighting each possible cash flow scenario by its liquidity-considered probability and then applying a risk margin relating to the inherent liquidity risk.

For a liability, this would represent an addition to the risk-free rate. The following addresses this point.

> An insurer may need some liquidity, but some argue that its liquidity needs are typically less than those of many other holders of highly liquid assets. Therefore, some argue that insurers can capture a liquidity margin by investing in relatively illiquid assets and that insurers often pass on part of that premium to policyholders. An insurer could invest in a highly liquid asset, but if it did so, it would be paying for liquidity it does not need. Therefore, some argue that insurance liabilities should be measured by using a discount rate that is not reduced by the full amount of the implicit option premium implicit in the rate for highly liquid assets. (IASB Agenda Paper 7G, discount rates, March 2006))

As stated above, the reason that insurers may need less liquidity in their asset portfolio is that the obligations of an insurance contract have a relatively low or usually predictable on-demand turnover, and some obligations like payout annuities cannot be surrendered at all or not without heavy penalties. Theoretically, a replicating asset for a liability for such an insurance contract would therefore require less liquidity than that embedded in yields for liquid risk-free assets such as most Government bonds and swaps.

In contrast, the theoretical justification for the use of liquidity premia in the liability valuation does not depend on whether the obligation has been traded or is tradable, from either the policyholder's perspective (second hand market) or the insurer's perspective (transfer of the obligation to another insurer). What matters is only the degree of uncertainty around the timing of the ultimate cash flow to be paid from whoever holds the assets to whoever owes the obligations. If the obligation can be sold from one insurer to another, this does not alter the timing of the ultimate cash flow, and illiquid assets could be transferred from the selling insurer to the buying insurer to exactly match the expected cash flows. In this case, the price paid by the purchasing insurer would then reflect the illiquidity of the ultimate liability cash flow.

If a liquidity premium is incorporated in the valuation, a further question is whether the liability for different types of insurance contracts should have different liquidity premia. This will, in theory, depend on how illiquid the liability is. In practice, since few insurance obligations are fixed and certain and any source of uncertainty over the timing of liability cash flows will reduce the extent to which a liquidity premium could be provided.

Whether liquidity premia should be considered at the level of portfolios rather than individual contracts is, thus, relevant. On a portfolio basis, the uncertainty of cash flows that exists at contract level is reduced, providing the insurer an opportunity to earn a liquidity premium, even for contracts with mortality or surrender risk.

For example, annuity payments depend on survivorship, which is reasonably predictable if experience on a portfolio of such contracts is available and the portfolio is large enough. Contracts that can be surrendered would be considered less predictable, as the timing of payouts can depend on the policyholder's behavior and reactions to economic or other events. Arguably therefore, immediate annuities should be valued using a higher liquidity premium than many savings products that can be lapsed on demand. In contrast, since many longer-tail general insurance contracts are less predictable as to amount and timing, they may use a lower or no liquidity premium.

5.3.2 Estimating the liquidity premium

A significant body of literature exists that attempts to demonstrate the estimation of liquidity premia in corporate bond spreads. All of these studies focus on the U.S. bond market.

A recent study by Longstaff, Mithal & Neis (2004) focuses on evidence from the credit default swap market to eliminate a default-related component from corporate bond spreads. They identify a regression relationship between the resulting non-default component and several indicators of liquidity (e.g., bid-ask spreads) on the data set. The average liquidity premia measured range from 50 basis points for AAA/AA bonds to 72 basis points for BB bonds.

The larger liquidity premia for lower-rated bonds highlights the risk-related element in the liquidity premium, where the inability to sell quickly commands a higher price for assets that are more likely to suffer significant sudden drops in value.

Other studies based directly on corporate bond data have derived lower estimates. For example, Driessen (2005) estimates a liquidity premium of about 10 basis points for a BBB bond. Li, Shi and Wu (2005) estimate that the liquidity premium explains 25% of the spread for investment grade bonds.

It is likely that the corporate bond market carries a significant mark-up in the liquidity premium relative to government bonds both due to credit risk and what is generally a more limited market. As our objective is to derive a liquidity premium to add to a basic risk-free rate, the above mentioned estimates form, at best, an upper bound.

One U.S. study (Longstaff (2001) directly examines the difference between zero coupon U.S. Treasury yields and yields on identical bonds issued by Resolution Funding Corporation (Refcorp), a U.S. government agency. The article explains that Refcorp bonds literally have the same credit risk as Treasury bonds. However, since Treasury bonds are more liquid and popular among investors (particularly during flights to liquidity), comparing their prices with those of Refcorp bonds may provide a way of testing whether there are flight-to-liquidity premia in Treasury bond prices. The study finds average liquidity premia in the range of 10bp to 16bp, depending on the term of the bond.

Other studies on U.S. Treasury data have derived an estimate of liquidity premia by comparing yields on recent and older issues of government bonds. The newly auctioned government security is referred to as an on-the-run or new bond, while the one auctioned earlier is referred to as an off-the-run or old bond. With rare exceptions, an on-the-run bond trades at a yield lower than the yield of a similar off-the-run bond, which the paper argues may reflect differences in liquidity. In a

recent study the observed spread between these U.S. yields over a period between January 1999 and February 2000 varied between 2bp and 10bp.

Based on the cited research examples, it could be argued that a liquidity premium might be justifiable for liability cash flows with a very high degree of predictability and hence illiquidity. Lower liquidity premiums would be expected to be applied to less predictable cash flows.

In addition, if an allowance is made in discounting for non-performance risk for a liability (see Section 8.3), it would be added to the basic risk-free rate. It may be justifiable to also incorporate a higher liquidity premium. This is because the reference for the liquidity premium would then be more similar to a corporate bond liquidity premium.

5.4 Linked and related approaches

If a cash flow to which discounting is to be applied is directly linked to a designated portfolio of assets or contract-specified asset performance, a different discounting approach may be appropriate. Rather than just reflecting the time value of money in a market-consistent manner, the objective of a financial reporting system may emphasize the consistency of assumptions to be applied. In this case, it may be more important for the applicable discount rates to be consistent with the cash flows to which they apply.

If, for example, the cash flows of a participating insurance contract are being measured, the expected investment returns and expected reinvestment rates on the specified set of assets would be reflected. In this case, the assumptions for policyholder behavior would be consistent with the assumptions for investment returns, and, thus, the effects of investment returns on the value to policyholders of any guarantees or options included in their insurance contracts would be reflected.

Where an insurance obligation is based in part or in full on a designated set of assets, two approaches might be taken to estimate the expected investment return rate that could form the basis for a set of discount rates, described as follows:

1. A bottom-up approach, where the discount rate would be equal to:
   Risk-free rate for the cash flow duration (see Section 5.2)
   + illiquidity premium (see Section 5.3)
   + credit characteristic premium for the insurance contract/financial instrument
   - investment expenses
   + margin for undiversifiable asset-liability mismatch risk

2. A top-down approach, where the discount rate would be equal to:
   Total nominal expected investment rate (which includes management's anticipated return)

- expected asset default effect
- asset default risk
- margin for undiversifiable asset-liability mismatch risk

When establishing a discount rate for a contract whose obligation is indirectly based on the insurer's invested assets (e.g., universal life insurance and life insurance or annuity contracts with excess interest), a combination of linked and un-linked approaches might be appropriate, although practically such a combination could become quite messy to calculate.

A linked method of discounting could also be useful when designated assets would be transferred to a third party purchaser along with the obligations.

Examples of the effect of a contractual linkage include participating contracts in certain jurisdictions and variable (unit-linked) contracts. Care is needed to ensure that in a particular case the cash flows being discounted do in fact relate to the underlying assets.

In the related, but not identical situation of a contract in which the cash flows are indirectly but imperfectly linked, although expected management behavior could be estimated, that is for example, based on observed policyholder sales illustrations and management strategies, it may also be appropriate to link the expected yield to expected investment performance, even though there is no direct 'formula' linkage.

Note that while the above described approach results in a consistent measurement basis, it may not be market consistent, as the future investment returns are not based on market rates but rather based on the expectation of the entity of its future investment returns.

To achieve a market consistent approach in the example of participating contracts, where excess interest above a minimum guaranteed rate will be granted to the policyholder, the replicating portfolio approach can still be used. In that case, the forward interest rates (consistent with in the current market yield curve) provide information on the value of the excess interest granted to the policyholder. However, these values are not certain and in reality the future rate may be different. In other words, for an appropriate calculation of the value of the profit-sharing, we must also analyze the deviations from the projected rates. In fact, we need to use swaption prices to calculate the value of the profit sharing. In case minimum interest rates are guaranteed, it is not sufficient to only consider a single scenario, as a single scenario can never capture the full extent of the (implicit) return guarantees embedded in the contract.

6. Risk Margin Measurement Methods

This section describes the objectives of the use of risk margins (margins over current estimates in IAIS terminology) and how several approaches to its measurement might be applied in theory and in practice. The section also includes a quantitative and qualitative comparison of the approaches. It is organized as follows:

- Section 6.1 The objectives of risk margins
- Section 6.2 Desirable risk margin characteristics
- Section 6.3 Possible approaches to risk margins
- Section 6.4 and Appendix A Statistical concepts underlying risk measurement
- Section 6.5 Approaches to quantifying risk margins - examples.
- Section 6.6 Quantitative comparison of methods
- Section 6.7 Context for risk margin measurement – pooling, diversification and reference portfolio/entity concept
- Section 6.8 Context for risk margin measurement –risks to be considered
- Section 6.9 Context for risk margin measurement – time horizon and risk perception
- Section 6.10 Practical issues
- Section 6.11 Qualitative comparison of methods.

Appendix B shows one life insurance and one annuity example prepared in more detail than the examples shown in Section 6.5.

6.1 The objectives of risk margins

In discussing the objectives of risk margins, it is first appropriate to discuss the context in which they apply, i.e., the nature of an insurance contract.

In general, an insurance contract contains an agreement by the insurer to provide, in exchange for a payment of one or more insurance premiums, agreed upon benefits to a beneficiary of the contract upon occurrence of specified uncertain or contingent future events affecting the life or property of the insured party, i.e., a transfer of such risks.

Two aspects of such a transfer can be distinguished:

1. Policyholder view. Policyholders are subject to certain risks as to the frequency, timing and/or severity of certain contingent events, which they cannot, or do not wish to, bear themselves, considering their own assessment of advantages of transferring those risks.

2. Insurer view. The insurer has the ability to manage these risks through a number of risk management techniques, including the pooling of similar risks, diversifying risk across multiple pools, reinsuring, or securitizing the risks.

While the transfer of risks to the insurer allows the insurer to pool and manage the risks, the ultimate financial amount of the insurance obligations will remain, by their nature, uncertain for a significant time period.

Until the transferred obligations are settled, the insurer bears a current obligation. That obligation is measured for both regulatory purposes and general purpose financial reporting and reported as a liability. It is generally agreed, including by the IAIS and the IASB, that the liability which is recorded should include an estimate of the expected value of future cash flows plus a risk margin, to reflect the remaining uncertainty. There is less agreement on how to determine the amount of risk margin in the liability. Two perspectives on this issue will be referred to in the following as "policyholder protection" and "provision for the cost of bearing risk".

The risk margin for 'policyholder protection' as an element of prudence. Ensuring the promises made by insurers to its policyholders is a primary objective of insurance regulators. To that end, insurance regulators generally have had the authority to specify the methods and sometimes assumptions with which assets and liabilities are valued in regulatory financial reports, as well as to specify the amount of capital, that an insurer needs to remain in business. This authority has differed by jurisdiction and has changed over time. Regulatory financial reporting regimes generally value each asset and each liability on a 'conservative' basis. In this framework, each asset and liability has a recorded value that covers adverse deviation that can be expected under normal circumstances. In this regard, capital is an additional provision to the cover more severe unfavorable outcomes.

Setting risk margins from the 'policyholder protection' viewpoint involves a determination of the boundary between the roles of risk margins and capital. Regulators require and policyholders benefit from a level of insurer liabilities and capital at levels such that total insurer resources are adequate to cover obligations to policyholders with a sufficiently high level (probability) of assurance. If risk margins were higher (or lower), then normally the required capital would be correspondingly lower (or higher). Although the quantitative distinction between risk margins and capital can appear somewhat arbitrary, the qualitative separation is reasonably clear.

A traditional insurance regulatory view is that risk margins are expected to cover adverse deviation expected under normal circumstances, while capital covers more unusual adverse deviations. Put differently, both risk margins and capital are available to finance the cost of adverse events, with risk margins providing the first level of protection and capital the second.

The risk margin as a provision for (the cost of) ***bearing risk – exit value approach***

For general purpose financial reporting, the IASB has recently proposed that the risk margin should be determined so that the current estimate plus risk margin represents a 'current exit value' i.e., '…the amount an insurer would expect to pay at the reporting date to transfer its remaining contractual rights and obligations immediately to another entity'[6].

Where a deep and liquid market for insurance obligations exists, this exit value would be observable in that market. The exit value determined from price observations from that market would include a provision for the *cost* of risk bearing. Alternatively, this provision can be viewed as the *reward or compensation* for bearing risk by the insurer. Generally, the financial component of insurance cash flows (current estimates) can be hedged/replicated by financial instruments (assets, derivatives, etc.) available in a market[7]. In these cases, it is possible to refer to market prices for similar cash flows for measurement purposes. In the terminology used in this paper, a market price includes both a discounted current estimate of expected cash flows and a risk margin in excess of that amount. However, it is not generally possible to separately identify those components systematically.

For risks such as insurance risks (e.g., mortality, morbidity, and unpaid claim obligations), there does not now exist such a market. They are labeled therefore as "non-hedgeable", although that is not a characteristic of the risk, but rather of the market that does not actively trade such risks. Note that a market for some of those risks could develop in the future, in which case reliable prices from such a market would be considered.

In the meantime, both the IAIS and IASB have suggested that the value of the liability should be determined using a model having three building blocks: the current estimate of the future contractual cash flows, a discount reflecting the time value of money and a risk margin. In its Discussion Paper, the IASB listed several ways that this risk margin might be determined.

This three-block model assumes that a rational transferee would require something more than the current estimate (even if transferor and transferee were to agree perfectly on the level of the current estimate). Otherwise, the transferee would not expect to receive anything for taking on the risk that everything does not work out as expected. This amount, the risk margin, can therefore be regarded as an additional amount associated with the uncertainty inherent in the future financial return from the contract. This risk margin would reflect the compensation to the transferee for the risk of taking on an obligation to pay uncertain cash flows.

[6] IASB, Discussion Paper, Preliminary Views on Insurance Contracts, Part 1: Invitation to Comment and main text, 2007, Section 93, page 59

[7] Hedging of cash flows is not always possible. For example, cash flows generated by life insurance contracts sometimes are expected to occur at a duration longer than that available from hedging instruments. The term "hedging" is under IFRSs a defined term referring specifically to a matching with derivatives. The term is here used in a broader sense, equivalent to matching or replicating.

Thus, under a market consistent approach, a reasonable basis for calculating this risk margin might be developed by applying the reasoning of the transferee to determine the additional amount (price) it might be satisfied with to take on the risk. Although what might be desired would be as much as possible, in a reasonably efficient market, the margin would be based on a reasonable return that reflects the risk of uncertainty. At a market equilibrium, the margin would also reflect the risks and returns of a likely diversified portfolio of investments available to the transferee. If observable evidence existed that transferees would take on the net obligations at a very low return in view of the uncertainty involved, then the risk margin would reflect this lower return.

The risk margin could then be estimated by various methods. The application of any acceptable method would incorporate knowledge or judgment as to what a rational market participant requires.

Link between the two risk margin perspectives

The policyholder protection and provision for bearing risk perspectives are linked.

Starting from the policyholder protection perspective, note that the objective a risk margin serves in regulatory liabilities is the ability to absorb a reasonable degree of uncertainty in experience. If experience is at least as favorable as that assumed in the current estimate with risk margins, the release of the excess risk margin creates a "profit" during that period that serves as a reward for the investor that has taken the risk; if experience is worse than expected, the risk margin covers some part of the expected losses. In essence, that is the same perspective an investor would have in taking over the liabilities, as this uncertainty defines the reward for providing for the expected costs. At first glance differences might exist as the regulatory selected security level may differ from the market participants' requirements for a price for accepting risk, but the IAIS view as provided in its *Second Liabilities Paper* in effect implies that there would not be a difference.

Starting from the provision for risk bearing perspective, any transferee would need to settle the obligations, as the transferor would be obliged to do. The IAIS has recognized that policyholder protection must be provided for in any transfer of liabilities. To do that, the IAIS, in its *Second Liabilities Paper*, paragraph 11[8] states "The IAIS stresses that any transfer would need to be made to an entity capable of accepting the transfer which, in the case of a regulated industry like insurance, implies that the transferee would also need to be regulated and capable of settling the obligation to the claimant/beneficiary." Accordingly, the IAIS believes that any transfer notion should be strongly influenced by the settlement obligations that the transferee would undertake. The transferee would need to provide capital or at least to proof its ability to cover losses from its

[8] Issues arising as a result of the IASB's Insurance Contracts Project – Phase II – Second Set of IAIS Observations, May 2006, page 5

resources. The risk margin is the cost for providing that capital or equivalent guarantee.

6.2 Desirable risk margin characteristics

In the *Second Liabilities Paper*[9], the IAIS takes the position that, "(w)ithout prescribing any one method(ology) at this stage, the IAIS believes that any methodology for calculating the risk margin should share certain characteristics."

The paper continues "(i)rrespective of the particular methodology chosen, acceptable methods should reflect the inherent uncertainty in the expected future cash flows and would be expected to exhibit the following characteristics:

- The less that is known about the current estimate and its trend; the higher the risk margins should be
- Risks with low frequency and high severity will have higher risk margins than risks with high frequency and low severity
- For similar risks, contracts that persist over a longer timeframe will have higher risk margins than those of shorter duration
- Risks with a wide probability distribution will have higher risk margins than those risks with a narrower distribution
- To the extent that emerging experience reduces uncertainty, risk margins will decrease, and vice versa."

The IASB identified the same properties as being desirable.[10] In addition, the RMWG believes it is desirable for the risk margin methodology to have the following characteristics:

1. Applies a consistent methodology for the entire lifetime of the contract;
2. Uses underlying assumptions consistent with those used in the determination of the corresponding current estimates;
3. Is consistent with other financial contracts;
4. Where possible, be determined in a manner consistent with accepted economic and actuarial pricing methodologies; and
5. Facilitates disclosure of information useful to stakeholders.

Next, note that risk margins affect the income statement as well as the balance sheet. The risk margin in the balance sheet should contribute to measurement of income so that it:

[9] Issues arising as a result of the IASB's Insurance Contracts Project – Phase II – Second Set of IAIS Observations, May 2006, page 11
[10] IASB, Preliminary Views on Insurance Contracts, Part 2: Appendices, Section F4, page 34-35, 2007

a. Provides up-to-date and relevant information about earnings from current business and the difference between expected results at the start of the period and corresponding actual results during the reporting period;
b. Is consistently determined between reporting periods for each entity;
c. Is consistently determined between entities at each reporting date
d. Shows earnings that provide users of financial statements guidance useful for making decisions.

Moreover, the RMWG considered the role of market consistency as a criterion for assessing a risk margin method. In general, the RMWG largely agrees that a risk margin should be sensitive to changes in the market to the extent observable. However, note that being market-consistent is not necessarily the same as being market-based or market-sensitive.

Some observers have expressed a belief that the use of a market basis for risk margins is inappropriate, in that unless and until a relevant market whose transaction prices are reliable arises, a risk margin would not be verifiable and that calibration would not be possible.

Others believe that the effort to measure market consistent values is worthwhile. In any event, a margin will always be relevant to the objective of a liability. As long as the measurement objective is based on market participants' views, changes of market participants risk averseness as reflected in prices for accepting risks also would be reflected in risk margins.

Finally, note that that Group Consultatif[11] has assessed risk margins methods in light of several objectives not included above. These are

- ease of calculation,
- consistency between classes of business,
- consistency with regulatory solvency other objectives, and
- consistency with IASB objectives.

The RMWG did not specifically endorse these Group Consultatif objectives, but they are considered in Section 6.11.

6.3 Possible approaches to risk margins

We have grouped the basic approaches (sometimes referred to as methods), or rather families of approaches, suggested for determining risk margins as follows:

1. “Quantile methods”, including
   a. Percentile or confidence levels,

[11] Groupe Consultatif. 2007. Solvency II Risk Margin Comparison, February 2006 http://www.gcactuaries.org/documents/ceiops_rmcomparison_130206.pdf

   b. Related methods, specifically, conditional tail expectation (CTE, also called tail value at risk or TVaR), and
   c. Multiples of the second and higher moments of the risk distribution;
2. Cost of capital methods;
3. Discount related methods;
4. Explicit assumptions; and
5. Conservative assumptions in the current estimate producing implicit risk margins

The first four of these methods are described in Section 6.5. There are other possible methods, including those using utility theory and hazard transforms[12] which have certain theoretical and/or practical advantages. We do not explore them further in this report, as they have not been sufficiently well investigated to determine how they would apply in this context.

The IASB's Discussion Paper identified the following approaches that might be used to establish a value for risk margins for general purpose financial reporting[13], together with the above family of methods within which it is categorized

a) Confidence levels [quantile]
b) Conditional tail expectation (CTE) [quantile]
c) Explicit margin within a range [explicit assumption]
d) Cost of capital [cost of capital]
e) Capital asset pricing method (CAPM) [although CAPM relates to asset values, it has been used to allocate capital that can affect certain risk margin calculations. It appears in actuarial pricing literature as one method for determining 'cost' in a rate of return method; it appears more appropriate to apply in determining parameters for other methods]
f) Deflator adjusted cash flows [discount related]
g) Multiple of standard deviation, variance, semi-variance, or higher moments [quantile]
h) Risk adjusted discount rate [discount related].

The IASB's preliminary views have rejected the use of implicit margins produced through unspecified confidence levels by use of conservative assumptions.[14]

[12] Zinkovsky, V. (2007)
[13] IASB Part II, section F9, page 36-37
[14] IASB Part II, section F9, page 36-37

The IAIS identified the quantile (confidence levels specifically) and cost of capital methods as "two methods being referred to or used by the industry and some regulators," but has not identified a preferred method.[15]

The current goal of the IAIS, expressed in its *Second Liabilities Paper* is to have the liabilities for insurance contracts financial reporting for regulatory and general purpose financial reporting to be the same. Both are moving toward a principle-based approach, although the objective of the IASB for consistent reporting for all industries and conformity to its Conceptual Framework may result in differences. As a practical matter, the current direction is likely to result in convergence, but that is not guaranteed at this time.

6.3.1 Risk margin approaches -- historical perspective

The following, largely in order of historical emergence of the method, provides a general background of risk margins used in the valuation of liabilities.

Risk margins based on explicit and/or implicit assumptions are a long-standing part of the regulatory approach to valuation of liabilities. These include the use of conservative mortality rates and the selection of less than market discount rates in the valuation of life and many health insurance contracts.

Adjustments to the discount rates have sometimes been used explicitly, e.g., with specified interest rates for discounting that are less than market interest rates. This includes the use of unpaid claim obligations for general insurance (GI, or property & casualty) on an undiscounted basis, with a lack of discounting assumed to offset the lack of an adjustment for risk. Certain discounting methods used in different contexts are based on a different set of economic principles, e.g., life insurance embedded value calculations that assess future distributable earnings using discount rates that include a risk premium assumed to be a level that the market requires – often based on a CAPM type approach.

The use of quantile methods for regulatory purposes is of more recent origin. Australian regulators, for example, require that liabilities for general insurance be set on the basis of confidence levels, subject to being at least a minimum number of standard deviations above the mean value. We understand, however, that this was, at least in part, intended as a simple proxy for what market participants would consider as representing a reasonable value.

Further, in general purpose financial reports, some entities choose to use quantiles to describe in the notes to the balance sheet the level of security achieved by the margins actually chosen, even if determined by other means.

[15] IAIS Second Liabilities Paper, 2006, page 12 and "The IAIS Common Structure for the Assessment of Insurer Solvency", February 2007, page 30

Cost of capital methods have been used for several years in life insurance embedded value calculations. It is also used as part of the Swiss Solvency Test (SST).

Conservative implicit assumptions have sometimes been used in the measurement of liabilities for insurance contracts. From a policyholder protection perspective, to the extent that conservative assumptions produce higher liability values, this is viewed favorably, but this is not part of the formal regulatory process.

The use of risk margins in general purpose financial reporting has differed significantly across jurisdictions. In some cases risk margins have provided for adverse deviation on either an implicit or explicit basis on one of the general methodologies listed above. In some cases, historical assumptions (as set at issue) have been used, often perceived to serve as an element of prudence (for example, the use of historic mortality rates in term life insurance that does not reflect expected future mortality improvements). Also, risk margins may be calibrated in a second step to eliminate any remaining initial gain and then allocated to earnings over time in proportion with the process of release from risk.

6.4 Statistical concepts

The key risk concepts needed to understand and evaluate the risk margin approaches include: distribution or risk distribution, normal distribution, standard deviation, coefficient of variation, skewness and the rate at which claim/policy obligations are settled. The following discusses each of these key concepts.

- A risk distribution (or simply, distribution) gives the probabilities that different outcomes of an uncertain process will occur.

- The width of a risk distribution can be defined by its coefficient of variation, which equals the standard deviation, divided by the mean. This description is useful because a standard deviation of 1 million is small if the mean is 100 million, but large if the mean is 500,000. The coefficient of variation is 1% in the first case and 200% in the second case.

- The normal distribution is a well known probability distribution. It has a form that `requires two parameters, the mean (or average) which indicates its central point and the standard deviation that indicates its width or uncertainty. It is sometimes described as well behaved for several reasons. First, it is ‘symmetric’, in that for each ‘good news’ scenario there is an identical and equally likely ‘bad news’ scenario. Second, risk measures such as confidence levels and conditional tail variation depend only on the standard deviation. So there will be a fixed relationship between risk measures based variously on standard deviation, confidence levels or conditional tail expectations. Finally, the central limit theorem demonstrates that any

distribution of homogeneous and uncorrelated risks will approximate the normal distribution as the number of risk increases to infinity.

- However, the normal distribution is rarely applicable to insurance situations, as there are never enough risks and the risks are correlated through inflation, mortality, court decisions, etc. Only in extremely large portfolios of risks with at most partial correlations would the total claim distribution be similar to normal.

- Most insurance risks have a high probability of having no claim or policy obligation during a reporting period. In some cases there may be a small probability of having a partial or small claim amount or obligation, with an even smaller probability of having a large claim. Statistically, distributions like this are described as having 'positive skewness' or being 'skew'. They have a parameter that represents the degree of 'skewness' (represented by γ, the Greek letter gamma), that is greater than zero. The normal distribution, because it is symmetric, has zero skewness.

  Combining many policies in a pool or portfolio often reduces but does not eliminate the skewness. For some types of coverage, e.g., coverage of natural catastrophes, combining policies may not reduce skewness, as such loss events either do not occur or arise under many policies simultaneously.

- Another factor that can affect the value of a risk margin is the time it takes to settle a claim or a policy obligation. The risk distribution and the settlement times can be related, as obligations that take longer to settle often have greater skewness and larger coefficients of variation.

In order to compare the risk margin approaches on a consistent basis we have developed a set of assumptions that cover a spectrum of insurance products. Table 6.1 and the notes below it summarize the assumptions.

Table 6.1 Assumptions used for risk margin examples

	Sample lines of business			
Variable	**Product A**	**Product B**	**Product C**	**Product D**
γ (gamma)	0.2	0.4	0.8	8
1. Coefficient of variation (CV)	3.0%	13.3%	26.1%	151.3%
2. Settlement pattern	Life – long	GI- medium	GI-longer	GI- medium
3. Increase in ratio of capital to discounted current estimate (p.a.)	0%	10%	10%	10%
4. Notional coverage type	Simple life products	Motor third party liability	'Risky' liability	Catastrophe coverage[16]
5. Risk distribution	NP	NP	NP	LN

[16] Example D related to unearned exposure plus claims settlement. The other examples relate to unpaid claims only.

Line by line notes:

1, 2: The skewness and coefficient of variation (CV) for our examples are discussed in Appendix A.

3. The three payment patterns are shown in Appendix A, Table A.1.
4. For Product A, the ratio of required capital to current estimates is assumed to remain constant during the runoff of obligations. For Products B-D the ratio is assumed to increase at the indicated percentage rate, e.g., 10% per year, e.g., 30%, 33%, 36%, 40%... The rationale is discussed in Section 6.5.2, subsection 'Release of Capital".
5. NP refers to normal power approximation. LN refers to log normal distribution. The risk distributions for Products A-C are compound poison models represented by the normal power approximation with the selected skewness and CV. For Products B and C the normal power approximations are very similar to lognormal distributions with the selected CV's. For product A, the lognormal equivalent would have a CV of 6.7%, rather than the selected 3.0%. Product D uses a lognormal distribution. Appendix A.5 compares the NP and LN distributions.

Note that the risk distributions and settlement patterns used here are illustrative, as are the notional coverage descriptions. There is a range of variation within each coverage and there are coverages with characteristics that fall outside the range of these illustrations.

Appendix A provides further information regarding distributions in general and those used in this report.

6.5 Approaches to quantifying risk margins - Examples

In the following four sub-sections we discuss the first four of the risk margin approaches listed in Section 6.3.

6.5.1 Quantile approaches

The use of confidence levels is the most widely recognized quantile method. Risk margin methods based on confidence levels express uncertainty in terms of the extra amount that must be added to the expected value so that the probability that the actual outcome will be less than the amount of the liability (including the risk margin) over the selected time period equals the target level of confidence. This level is also sometimes called the "value at risk" or VaR.

Conditional Tail Expectation (CTE, also called Tail Value at Risk, or TVaR, is defined in Appendix A.2) is a modified approach, a mixture of quantile and the mean value of all those cases exceeding the quantile, to overcome some disadvantages of the confidence level approach.

Table 6.2 shows confidence level risk margins for the four sample products described Table 6.1 of Section 6.4. We illustrate the 65%, 75% and 90% confidence levels because these are levels sometimes considered appropriate for regulatory purpose. We selected CTE levels of 40% and 75% because these are similar to confidence levels of 75% and 90% for products A and B.

**Table 6.2 Risk margins at selected confidence levels
Number of standard deviations***

Coverage type	γ (gamma)	Number of standard deviations required to reach required level of confidence				
		Confidence level			CTE	
		65%	75%	90%	40%	75%
Product A	0.2	0.36	0.66	1.30	0.64	1.30
Product B	0.4	0.33	0.64	1.32	0.63	1.33
Product C	0.8	0.27	0.60	1.37	0.62	1.30
Product D	8.0	(0.11)	0.10	0.81	1.00	1.75

*The risk levels are expressed as multiples of the standard deviation, because on that basis, the results do not depend on the width of distribution.

Table 6.3 measures the risk margin as a percentage of the discounted current estimate.

**Table 6.3 Risk margins at selected confidence levels
% discounted current estimates**

Coverage type	γ (gamma)	Percentage of discounted current estimate				
		Confidence level			CTE	
		65%	75%	90%	40%	75%
Product A	0.2	1.1%	2.0%	3.9%	1.9%	3.9%
Product B	0.4	4.4%	8.5%	17.6%	8.4%	17.6%
Product C	0.8	7.1%	15.7%	35.7%	16.2%	33.9%
Product D	8.0	-16.0%	15.1%	123.2%	51.7%	164.6%

Observations from Tables 6.2 and 6.3 include the following:

- Using a risk margin equal to a fixed number of standard deviations produces positive risk margins, even for highly skew distributions.

- In Table 6.2 for the 65% and 75% confidence levels, the risk margin measured as a number of standard deviations decreases as the risk distribution becomes more skewed (down the column). Thus, in order to have the risk margin at the same multiple of standard deviation for all policy types, the confidence level would be larger for distributions with more skewness.

- In Table 6.3 for the extreme event, Product D, the risk margin is negative, meaning that the 65% confidence level is lower, not higher than the mean of the distribution. This shows that at least for certain extreme distributions, confidence levels without some adjustment may not be appropriate risk measures.

- Using CTE rather than the confidence levels produces risk margins that are consistent with confidence level risk margins for the less skew distributions, but does not decrease and/or produce negative risk margins even for the most skew distributions.

- If the standard deviation is considered as a risk measure, the results are consistent with confidence level or CTE for the less skew products. For example the 75% confidence level corresponds to approximately 0.65 standard deviations above the mean for all but product D.

- For the more skew Product D, the standard deviation measure is better than the confidence interval measure because the risk margin, in standard deviations or absolute amounts, does not decrease.

- The standard deviation is not as sensitive to risk as the CTE. The number of standard deviations corresponding to the 40% CTE level needs to increase from 0.62 to 1.00. A similar increase is needed at the 80% CTE level.

- For the very risk product D, the CTE risk measures require a margin equal to more standard deviations than the less risky products. The CTE is therefore more risk sensitive than the number of standard deviations, and may be a better risk measure.

Variance, semi-variance or higher moment methods are not illustrated in this calculation, as there is no literature on their practical applications in determining risk margins for liabilities.

The risk margins illustrated in Tables 6.2 and 6.3 assume that risk would be measured separately for each line of business based on the experience of the reporting entity alone. Section 6.7 discusses alternative contexts in which to measure the confidence levels.

6.5.2 Cost of capital method

The cost of capital method is a generally accepted method for setting profit margins in premium rates and in a simplified form also used for reporting embedded values. As such, it is a method that market participants could reasonably be expected to consider in setting terms for the cost of bearing risk.

To apply the cost of capital method, the applicable capital and cost of capital is needed both at the reporting date and at each period of development of the runoff of the obligations. In addition, since the capital generally depends on the current estimate of the obligation, the expected cash flows measured at each future reporting period until the policy/claim obligations are settled are also needed.

Cost of capital

The cost of capital refers to the amount of return, in addition to the amount earned by the insurer from its investment of capital that is required for the total return on the insurance enterprise to be adequate. The cost referred to here is generally the pre-income tax basis; however, for the purpose of the illustrations in this paper, income taxes are ignored. Note that in practice, taxes can be a significant aspect of the cost. For example, ignoring taxes, if the total required return for a transferee is 12% and the return on investments backing capital is expected to be 7%, then the cost of capital would be 5%.

There is no currently accepted method for determining the cost of capital for the purpose of determining risk margins. A value of 6% is used in the SST for a capital level described as a 99.5% confidence level (i.e., capital determined using the quantile approach) and is described as approximating a BBB financial rating. A value of 4% has been used in various industry presentations as applicable to entities with capital at a 99.95% level described as approximating an AA financial rating level. We have used 6% in most of the illustrations in this paper, but are not proposing that 6% or 4% are appropriate values.

This is further discussed in the Section 6.10, Practical issues

Capital

Tables 6.4 and 6.5 show the capital using the four coverage examples and using three levels of confidence to determine the capital.

These examples assume that the capital is based on a confidence interval approach related to the reporting entity variability in its claim/policy obligation run-off for the single line of business. The actual context for measuring capital could include the effects of diversification, of the combination of the reporting entity portfolio with a larger reference portfolio, of operational risk and other issues. Section 6.7 provides more information on the effect of other contexts for measuring capital.

Table 6.4 Capital at selected confidence levels
Number of standard deviations

Coverage type	γ (gamma)	Number of standard deviations required to reach the selected level of confidence				
		Confidence level			CTE	
		99%	99.5%	99.95%	99%	99.5%
Product A	0.2	2.47	2.76	3.62	2.87	3.14
Product B	0.4	2.62	2.95	3.95	3.08	3.39
Product C	0.8	2.91	3.33	4.60	3.49	3.89
Product D	8.0	3.95	5.40	12.55	7.16	9.08

**Table 6.5 Capital at selected confidence levels
% of discounted current estimate**

Coverage type	γ (gamma)	Percentage of discounted current estimate				
		Confidence level			CTE	
		99%	99.5%	99.95%	99%	99.5%
Product A	0.2	17%	18%	24%	9%	9%
Product B	0.4	35%	39%	52%	41%	45%
Product C	0.8	76%	87%	120%	91%	101%
Product D	8.0	598%	816%	1898%	1083%	1374%

The five levels of capital shown in Tables 6.4 and 6.5 are those that have been suggested for capital in various settings. The 99.5% confidence level is referred to in the Swiss Solvency Test, the U.K. ICAS regulatory regime and the Australian Internal Model Based approach to required capital. This could be thought of as roughly a 1 year in 200 per entity or a 1 in 200 annual entity failure rate. It is also sometimes interpreted as being equivalent to a BBB bond which has a similar risk level, although the historical BBB confidence level has varied over time. Also, the BBB default rate refers to defaults per year. In the insurance context, the confidence level also often refers to the entire runoff of the obligations (see Section 6.9 for further discussion). Similarly, the 99.95% confidence level is often described as equivalent to a AA risk level.

Features of capital include the following:

- From Table 6.4, looking from Product A to Product D, capital, measured in numbers of standard deviations, increases as the skewness increases.
- From Table 6.5, looking from Product A to Product D, capital, measured as a percentage of the discounted current estimate, increases even faster than the number of standard deviations because the coefficient of variation increases from Product A to Product D.
- In Table 6.4, looking at the 99.5% confidence level and the 99% CTE level, capital, measured in numbers of standard deviations, is similar for Products A-C. However, for Product D, with a much larger skewness, the 99% CTE is significantly larger than the 99.5% confidence level (7.16 vs. 5.40).
- The difference in risk margins between products is reflected by the different amounts of capital and different payment patterns. In these examples the cost of that capital is assumed to be the same percentage for all products, although that might not be the case in practice.

Although conceptually the use of CTE is always superior to the simpler confidence level method, the additional refinement involved does not always make a significant difference in the risk margins derived. In fact, the difference in results between them is relatively small, except in the case of highly skewed or non-linear distributions.

Release of capital

The amount of capital needed usually declines as the amount of the unpaid claims/policy obligations declines, even though not necessarily in a uniform way. Nevertheless, although the number of claims/policies remaining unsettled normally decreases as the runoff progresses, the coefficient of variation and skewness of the distribution of losses can increase because during run-off the risk profile will change (the more complex claims that are usually more skewed will take a longer period to run off).

Moreover, particularly for many general insurance lines of business, the nature of late-settled claims is different from that of early-settled claims. The later-settled claims are often larger and subject to more disputes and thus experience would be expected to exhibit more variability. Also, later-settled claims are often more subject to uncertain economic effects, e.g., inflation, social inflation, and judicial activity, all of which can increase the variability in ultimate payments.

A detailed analysis of required capital by age may be required in an actual application. For simplicity in the examples given in this paper, we assume that capital, as a percentage of the current estimate, increases uniformly at 10% per year.[17]

Sample calculation

Table 6.6 illustrates the cost of capital method as applied in the SST to Product B (similar to motor liability coverage). The risk margin at the reporting date from this example is 4.5%, the value shown in column 7 of line 1. The 4.5% is the present value of the cost capital amounts in column 5 over the run-off period (column 3). Appendix A contains further details regarding the calculation.

Table 6.6 –Cost of capital calculation for Product B ("Motor")

1	2	3	4	5	6	7
Since reporting date	Liability	Capital %	Capital	Cost of capital	Risk margin	Risk margin as % of liability
0	100	39.1%	39.1	2.3	4.5	4.5%
1	58	43.0	25.0	1.5	2.4	4.1
2	27	47.3	12.8	0.8	1.0	3.6
3	6	52.1	3.1	0.2	0.2	4.1
4	2	57.3	1.1	0.1	0.1	3.3
5	0	63.0	0.0	0.0	0.0	0.0

Assumptions: The initial capital is based on a 99.5% confidence level[18] capital as a percentage of discounted current estimate increases 10% per year, the risk free interest rate is 4% and the cost of capital is 6%.

[17] SST and other cost of capital applications for general insurance have assumed that capital is released at the same rate that claims are paid. Although this assumption is understandable and easier to apply, it is often unrealistic. This is an area for which further research should be conducted.

[18] Applied over a one-year time horizon; see Section 6.9 for further discussion.

Sensitivity tests

Applying this method and assumptions to the four example coverages produces the results in Table 6.7, with a description of each line following the table.

Table 6.7 Cost of capital sensitivity tests

Cost of capital assumptions	Prod. A	Prod. B	Prod. C	Prod. D
1. Base case	4.1%	4.5%	36.8%	94.7%
2. 99.95% VaR[14] and 4% cost of capital	3.6	4.0	34.0	146.9
3. Capital based on 99% CTE[14]	4.3	4.7	38.7	125.6
4. Constant capital ratio	--	4.2	25.5	88.4

Line 1, the base case, uses the assumptions indicated in the note to Table 6.6.

Line 2 illustrates the effect of setting the initial capital to a 99.95% level over a one year time horizon[19] standard but using a 4% cost of capital. The increase in capital from a 99.5% to 99.95% level alone raises the risk margin. The reduction in cost of capital, in contrast, reduces the risk margin. These two factors combine to produce risk margins within 10% of each other, except for the more highly skewed Product D where the increase in capital requirement has a much larger effect than the reduction in cost of capital.

Line 3 illustrates the effect of setting the initial capital to a 99% CTE level and the use of a 6% cost of capital. The results are relatively similar to the line 1 result for Products A and B, with lower skewness. The CTE-based risk margins are higher for Products C and D, with higher skewness. The result for Products C and D follows from the higher capital requirements implied by the CTE approach. We believe the CTE values represent a better reflection of risk for products with a higher degree of skewness than the confidence level results.

Line 4 illustrates the effect of assuming the ratio of capital to discounted current estimate is constant, equal to the ratio at year 1 in Line 1. No value is shown in line 4 for Product A because the base case assumed that the capital ratio was constant. There is about a 7% difference between the base case and line 4 for Products B and D that is assumed to have the short GI payment pattern. The difference is much larger for Product C that is assumed to have the long GI settlement pattern. Thus, the relation to the current estimate is more significant for products with variation in capital ratio and longer settlement periods.

The values shown in Table 6.7 are based on the SST approach. Appendix A.3 shows alternative assumptions used in the cost of capital method.

[19] Applied over a one-year time horizon; see Section 6.9 for further discussion.

6.5.3 Discount-related risk margins

Risk adjusted returns

A risk adjusted discount method discounts future expected cash flows using the risk free interest rate minus a selected risk adjustment. The risk adjustment might vary by line of business, age of run-off or other factor that affects the risk distribution.

One such method is to assume the risk adjustment equals the risk free rate (or other appropriate unadjusted discount rate). In that case, there is no discount applied to the measurement of the liability. This is effectively the method used for most U.S. GAAP and regulatory reporting of general insurance in the U.S. and some other jurisdictions.

More sophisticated methods of this type would use a risk adjustment that depends on the line of business and perhaps the age of the claims/policy obligations.

Leigh (2004) showed that if capital is a constant percentage of the discounted current estimate, then for each line of business there is a risk adjustment such that the cost of capital method produces the same result as the risk adjusted interest discount method.

Deflators

Deflators, identified in the IASB Discussion Paper, are usually applied to asset values. There are currently no practical examples in the literature on how to apply them to non-hedgeable risks in insurance obligations

Examples

Table 6.8 shows the risk margins implied by using two discount related methods: using undiscounted liabilities and using liabilities discounted at 2% less than the risk free rate.

Table 6.8 Risk margin as % of discounted current estimate
Discount related risk margin methods

Coverage type	γ (gamma)	Discount assumption	
		No discount	Risk free less 2%
Product A	0.2	44.6%	19.0%
Product B	0.4	7.7%	3.7%
Product C	0.8	23.4%	10.7%
Product D	8.0	7.7%	3.7%

Products B and D are shown to have the same risk margin, even though intuitively the extreme event risk would require a larger risk margin. This occurs because the discounted-related risk margin only reflects timing in claim payments

and no other features of the risk distributions, and Products B and D are assumed to have the same payment patterns.

Also, because the obligations involved in the life insurance product (Product A) have the longest time to settle, it has the largest rate of discount in these methods even though it may have the lowest degree of risk.

6.5.4 Explicit assumptions

The RMWG found that there can be different interpretations of the terms 'explicit' and 'implicit'. The IASB Discussion Paper provided an example of an explicit risk margin that might meet its proposed criteria and several examples of implicit approaches that it did not believe met its proposed criteria for risk margins.[20] The IASB paper did not define 'explicit' risk margins or generally distinguish between 'implicit' and 'explicit' risk margins. However, the IASB requires that risk margins are determined explicitly for each individual risk, rather than being considered implicitly in other components like the discount rates or current estimate, without specifically reflecting the individual risk. It is assumed that the IASB recognizes that the latter is an "implicit" risk margin. For the purpose of comparing risk margins based on 'explicit assumptions', risk margins are treated as being explicit if the amount of the margin over the current estimate is specifically calculated rather considered implicitly by an unspecific (i.e., not specific to the individual risk) adjustment of discount rates or current estimate. This distinction does not necessarily relate to disclosure. The RMWG refers here to a special case of those risk margins, referred to by the IASB as explicit, i.e., where the margin is determined separately, but without specifically reflecting the individual risk.

In summary, for the purpose of comparing risk margins based on 'explicit assumptions', risk margins are treated as being explicit if the amount of the margin over the current estimate is specifically calculated and disclosed.

Examples of margins where the effect of the assumptions could be calculated and disclosed include the following:

1. Use a specified mortality, morbidity or other table. Use the current estimate of a mortality table, adjusted by x% to reflect risk (x being positive for life insurance and negative for annuities).

2. Use a minimum loss ratio until an exposure period is sufficiently mature. This often has been applied to general insurance 'unearned exposures'.

3. Use an explicit discount rate that is lower than the risk free discount rate.

[20] IASB, Part 2:Appendices, pages 36-37

4. Use a fixed percentage risk margin assigned by line of business, e.g., 5% for motor liability, 10% for risky liability, etc.

5. Use the cost of capital approach, by applying a fixed cost ratio on a regulatory based capital, which is not specific to the individual risk, e.g., simply a fixed ratio of statutory liabilities or premiums.

The first three examples are currently used in regulatory financial reporting in some jurisdictions. However, the calculation and disclosure of the difference between the current estimate and the regulatory liability is not typically part of the financial reporting regime, and to that extent, as currently applied, would be considered an implicit assumption.

An example of an implicit assumption would be the use of historical mortality rates for term insurance, without determining the implied risk margin.

6.6 Quantitative comparison of methods

Table 6.9 below compares the examples from the methods described in Section 6.5.

Table 6.9 Comparison of risk margins from different methodologies

Risk margin approach	Product A	Product B	Product C	Product D
1. 65% confidence	1.1%	4.4%	7.1%	-16.0%
2. 75% confidence	2.0	8.5	15.7	15.1
3. 90% confidence	3.9	17.6	35.7	123.2
4. 40% CTE	1.9	8.4	16.2	51.7
5. CoC - 99.5%VaR*	4.1	4.5	36.8	94.7
6. 0% discount	44.6	7.7	23.4	7.7
7. 2% discount (4% risk free less 2% risk adjustment)	19.0	3.7	10.7	3.7
*Initial capital %	8.3	39.1	86.8	816.3
Notional coverage	Simple life products	Motor 3rd party liability	'Risky' liability	Catastrophe coverage

The following are observations from Table 6.9:

For product A, the cost of capital risk margin is similar to that of the 90% confidence results. For the risk-adjusted discount rates used above, the discount adjusted margins are much greater than those resulting from the use of the cost of capital or quantile methods.

For product B, the cost of capital method produces risk margins similar to those applying a 65% confidence interval. Undiscounted liabilities would have a risk margin similar to the 75% confidence level. An interest rate risk adjustment of somewhat less than 2% would produce results consistent with the cost of capital method and a 65% confidence level risk margin.

Product C shows very different results for the 75% confidence level, undiscounted liabilities and cost of capital methods. In this case the cost of capital method has the largest indicated risk margin, slightly higher even than the 90% confidence level risk margin.

For Product D, the range of possible risk margins is very wide. Use of the CTE measure in the quantile method would avoid the negative risk margins that would be calculated using confidence levels. The discount-related methods produce, by far, the lowest risk margins, because the variability in this coverage is not related to the time it takes to settle the obligations.

In general, we observe that for products with narrower risk distributions, similar risk margins are easily produced by different methods. As the product becomes more risky, the risk margin amount becomes increasingly sensitive to the methodology used.

6.7 Context for risk margin measurement—pooling, diversification and reference portfolio/entity concept

Pooling and diversification

Generally, pooling of similar risks in portfolios or diversification by combining portfolios that are sufficiently uncorrelated reduces risk, and therefore could result in a lower coefficient of variation and skewness of the risk distribution. Therefore, using the methods described in the previous section, the indicated risk margins would be reduced by considering pooling and diversification.

The degree of pooling and diversification that would be reflected for different financial reporting systems has not yet been determined. Risk margins might be based on the entity's own size but separately by line of business (no inter-portfolio diversification), an entity's own size and diversification by line, the entity group pool size and diversification, the average pooling and diversification achieved by the insurers in the local industry of the entity or in the area of the world where the group is active, or by the potential designated and preferred acquirer of portfolio locally or globally, or other given level. We assume this will be resolved when the reporting standard describes the accounting objective to be measured.

See Section 7 for additional discussion about pooling and diversification. See Appendix B and C for detailed calculations and further discussion of diversification.

Reference portfolio/entity concept

Historically, risk measurement was performed only on an individual entity or group basis, with little regard to pooling and diversification of other entities in the industry.

The IAIS has proposed that "similar obligations with similar risk profiles should result in similar liabilities", even when the obligations are in different entities. To achieve the IAIS objective using risk distributions, e.g., the quantile or cost of capital methods discussed above, the individual entity experience cannot serve as the sole basis of measurement of risk margins. If that were the case, the risk margin, and the liability which included that risk margin, would be larger in a small entity than in a large entity, each identical except that the small entity had fewer such risks. In addition, to do so would mean that two entities, one with risks from line of business X and the other with the same number of identical risks of type X but also having risks of type Y (where the risks X and Y are not perfectly correlated), then the entity with risks X and Y would measure a smaller risk margin per unit of risk X than would entity Y.

One way to achieve the IAIS objective is to measure the reporting entity risk margin by considering how the risk margin in the reporting entity portfolio would be valued by a potential standardized entity, notionally representing a transferor. We call this transferor a 'reference entity' or equivalently speak of measuring the risk margins for the reporting entity liabilities as part of a 'reference portfolio'. The use of a 'reference' entity or reference portfolio in this context constitutes a new approach.

In applying this reference approach the value of the liabilities might be based upon what that value would be for a quality-rated insurer with appropriate industry levels of pooling and diversification, based on the circumstances of the industry in the jurisdiction (or even a part of it) where the legal entity participates. In this way, the risk margin for the reporting entity (in case of a consolidated group determined, perhaps, on the basis of each legal entity) would be the risk margin that would have been determined as if the portfolio was part of the reference entity.

One definition of a *reference entity* could be a large, multi-line, diversified insurer with business similar in nature to the portfolios subject to the valuation.

1. "Large" means large enough that "process risk", the random fluctuation around the expected value unavoidably present in each stochastic process (in some jurisdictions referred to as "random deviation risk"), is as small as observably achievable in the respective industry of the selected jurisdiction (local or global).

   For many types of insurance, given that the reference entity is large, the process risk will be negligible compared to parameter and model risk, i.e., the additional variability in outcomes that occurs because the process is not fully

understood or there is a significant uncertainty regarding what the mean is, the model used might be incorrect to some degree and/or the actual model parameters will vary from the estimated parameters.

Process risk may be significant for some coverages, e.g., property-catastrophe and high-layer excess property or liability coverages. Parameter and model risk for the reference entity may not be smaller than in a smaller entity.

2. "Multi-line, diversified" means the realistic benefits of risk diversification across portfolios and territories (including within and between countries to the extent that such diversification is observed in the industry, as there might be jurisdictions without such multi-line and diversified examples) are observable and consequently expected to be considered by such an entity (and in fact any market participant) in setting the price for accepting risks.
3. "Business similar in nature" means that determination of the characteristics of the reference entity is based on a review of an appropriate set of entities that are in the same business.
4. For the cost of capital method, the financial strength rating of the insurer is considered, as it affects both the target capital and the cost of that capital. However, the sensitivity tests in Section 6.5.2 suggest that, in at least some cases, if capital requirements and cost of capital are developed on a consistent basis, the effect on risk margins may not be significant.

As use of a reference entity that cannot be observed is a relatively new concept, it may be difficult to currently obtain agreement with respect to specific assumptions without further guidance or research. The reference entity would likely not be a particular entity in the industry.

To the extent that the reference entity realistically reflects the market for transfers, considering the margin in this context could be considered as being market consistent.

Some working group members have observed that since such a reference entity is not observable, calibration and comparable assumptions for similar portfolios may prove difficult (and perhaps not possible). Other working group members believe that the standard setter or regulator will provide sufficient guidance to make this practical.

Further research and discussion of the practical application of this approach is encouraged.

6.8 Context for risk measurement--risks to be considered

The discussion and examples in Sections 6.4-6.6 assumed that all relevant risks were included in the risk distributions. This applies whether we are measuring risk from the perspective of the reporting entity or the perspective of the reference entity/portfolio.

For the current discussion of risk margins[21], risks reflected in the risk distribution are all non-hedgeable risks associated with the runoff of claims/policy obligations, including the risk of variability in the amount of settlement obligations, reinsurance credit risk[22], and operational risk (for further discussion, see Section 8.4), but not including market or credit risk for assets because those are hedgeable. Assuming that is the range of risks considered, Table 6.10 summarizes some of the typically observed risks and identifies which are to be included in the risk distributions.

Table 6.10 Summary of risks

Business Type	Risk type	Included?
Life	**Mortality**	
Life	Trend uncertainty	Yes
Life	Level uncertainty	Yes
Life	Volatility	Yes
Life	Calamity	Yes
Life	Credit risk on reinsurance	Yes
General	**Property & casualty**	
General	Current non-catastrophe uncertainty	Yes
General	Current non-catastrophe volatility	Yes
General	Current catastrophe	Yes
General	Catastrophe credit risk of reinsurer	Yes
General	Claims development-volatility & uncertainty	Yes
Health/Disability	**Morbidity**	
Health/Disability	Current uncertainty	Yes
Health/Disability	Current volatility	Yes
Health/Disability	Prior	Yes
Health/Disability	Calamity	Yes
All	**Expense**	Yes
All	**Persistency**	
All	Volatility	Yes
All	Calamity	Yes
All	Uncertainty	Yes
All	Premium re-rating	Yes
All	Effectiveness of reinsurance transfer	Yes
All	**Operational Risk Capital***	Yes
All	**Credit**	No
All	**Market**	
All	Interest Rate	No
All	Currency	No
All	Real Estate	No
All	Equity	No

*Operational risk applicable to the liability runoff, i.e., liabilities and assets related to those liabilities.

[21] IAIS *Structures Paper* (2007), Ruygt (2006), CFO Forum (March 2006), and the SST methodology.
[22] Reinsurance credit risk might be hedgeable to some extent. The provision in the risk margin would reflect the credit risk that cannot be hedged and/or the cost of hedging the risk that is not already included in the current estimate of reinsurance recoveries.

In risk margins as applied up to now, for example as applied in Australia for general insurance regulatory reporting and less formally in other jurisdictions, the risk distributions relates to claim/policy obligations and does not relate to operational risk or reinsurance credit risks. That is a choice made by the applicable regulators, not a necessary characteristic of the specific measurement approach. In our discussions we assume that all methods considered would be applied to risk distributions that considered all of the risks described above.

As multiple risks are involved in insurance contracts, it is necessary to consider the appropriate way to reflect a combination of risks. Section 6.7 discusses the combination of risks with respect to combining numbers of risks and different lines of business. Appendix C discusses issues related to combining the different types of risks identified in Table 6.10.

6.9 Context for risk margins - time horizon and risk perception

The determination of the proper risk distributions to apply, as used for estimating risk margins directly or in estimating capital used in some risk margin methods, considers the time horizon required for the reporting purpose.

In the *IAIS in Common Structure for the Assessment of insurer Solvency*, time horizon is discussed for both capital and risk margin purposes. In this IAIS paper the time horizon is identified as including a 'shock period', perhaps one year, and an 'effect horizon' which is the entire period over which the shock will impact the insurer, potentially the period until all obligations are settled.[23]

This suggests two different approaches:

1. The time horizon for the risk margin relates to the full runoff of policy obligations and hence is based on the variability, estimated at the reporting date, between estimates of the value of the obligation at the reporting date and the actual value when the obligation is settled (Runoff test).

2. The time horizon is only a specific time period (e.g. one year), whereby the amount of capital is calculated by estimating the change in surplus (market value of asset minus market value of liabilities) with a specific percentage of probability (e.g. 99.5% as in Solvency II) of being sufficient to cover the liabilities need one year hence (Change in Surplus Test).

We believe these two approaches will produce similar results, as the value of the liabilities is always calculated as an estimate of the ultimate settlement value hence representing the full range of possible outcomes.

[23] IAIS, *The IAIS Common Structure for the Assessment of insurer Solvency*, Structure element 11 and discussion following, page 27-28, February 2007.

The measurement of liabilities for insurance contracts considers the full range of possible outcomes and hence would, to the extent practical, reflect any changes in risk perception that may occur in the future.

Note that there is merit in arguing that changes in future risk perception that differ from the current perception should impact the measurement of the risk margins (as well as the measurement of capital). Estimating future changes (different from observed historical changes) represents a complex and very broad issue that we suggest be considered in a future update of the IAA *Blue Book* or other solvency-related paper.

More discussion on the topic of risk distributions in the context of time horizon and change in risk perception is included in Appendix A5

6.10 Practical issues

This section discusses several of the practical issues associated with various risk margin approaches.

A possible simplified approach to reflect diversification and pooling

Section 6.7 discussed the use of a reference entity. With respect to that issue, a possible step between the use of a reference entity and own-entity pooling levels would be for the reporting entity to calculate a risk margin based on its own business scaled up to a sufficiently large size. This would make measurement of scale more similar between entities but would not adjust to a common level of diversification and not fully achieve the IAIS objective.

This is summarized in the following table:

Table 6.11 Risk context options

Basis of calculations	Liabilities similar across entities?
Use reporting entity	No
Use scaled up entity	Yes, if no diversification No, if diversification
Use standardized reference entity	Yes

In Australia, where confidence levels are used for risk margins for claims liabilities for non-life insurance, the context includes pooling and diversification within the reporting entity and is applied only to liabilities net of ceded reinsurance. In the SST test, the basis for capital by line of business reflects the degree of diversification within the entity.

Calibration and consistency

Each risk margin methods require assumptions which need to be selected by a combination of judgment and data. These areas include the following:

- "Cost" in the cost of capital method
- Confidence level or other quantile level for quantile methods
- Multiples of higher moments
- Risk adjustments in the risk adjusted discount methods
- Selection of values for explicit assumptions.

With respect to these parameters note the following:

- For all approaches, the calibration to market-based values, i.e., 'actual' transfer values is problematic, as there are few transfers with observable prices that provide reliable calibration benchmarks. In many cases, prices are not publicly available, involve special circumstances or refer to such complex conglomerates of transferred business, for which it is not possible to derive prices for specific relevant parts.

- Disclosure of and/or regulatory guidance regarding methods and the resulting margins will tend to produce consistency between entities over time.

- If any of the risk margin method(s) becomes a basis for transfers in the future, data might make calibration more reliable over time.

Definition of solvency for capital modeling in the cost of capital method
Some working group members have observed that current actuarial practice for capital modelling includes two different tests for adequacy of total financial as follows:

a. Capital is determined so that at any time during the runoff period there is a given probability (e.g., 99.5%) that assets are sufficient to cover current estimates and risk margins, or

b. Total assets are determined such that there is an acceptable probability (e.g., 99.5%) that claim payouts will not exceed assets.

As shown in Appendix A3, these definitions produce somewhat different risk margins. Method b can produce a lower risk margin because it provides capital to protect expected settlement values, rather than expected settlement values plus risk margin. Method a is consistent with the IAIS Common Structure guidelines (Structure Element 8, page 25).

Although capital assessment is not the focus of this paper, for the measurement of the liability regulatory and/or professional guidance may be required to ensure consistency in results.

Risk margins and income--regulatory considerations

While the effect of risk margins on income is likely to be small relative to changes in other aspects of liabilities, regulatory rules that use income measures may need to be re-evaluated. Two examples are discussed below.

- Regulatory guidance on distributions to shareholder or policyholder based on income may need to be revised based on changes in the way that income is determined.

- In most jurisdictions fast growth by entities may produce regulatory operating losses described as 'capital strain'. If reported income in the case of fast growth in the revised reporting regime is no longer associated with capital strain, then regulatory attention to the risks of fast growth will have to be identified in some other way; for example, special consideration and possible adjustment would have to be given as to whether capital models make suitable adjustments for the effect of growth risk on recently written insurance contracts.

Reliance on models

It would not be appropriate or possible to use capital from published financial statements to calibrate the capital in the cost of capital method. In contrast to the capital used in the cost of capital method, regulatory capital of an insurer relates to all of the entity's risks and strategic choices.[24] For the purpose of risk margins, the capital level, as discussed in Section 6.8, deals with only certain risks and not with all of the risks associated with an ongoing entity. Few, if any, entities currently disclose their capital separately for those risks, so calibration by comparison to other entities is not currently practical. Even information on capital from run-off entities may not be relevant, as they are few in number and their situations usually have unique characteristics that make application to the "normal" situation problematic.

Thus, the use of cost of capital or quantile methods requires more sophisticated modeling than explicit assumption methods.

For cost of capital or quantile methods,

1) Since some insurers may not be able to construct the models needed, they may have to utilize benchmark ratios. For capital purposes, the benchmarks might be something similar to those in standard capital requirement (SCR) being discussed in the context of Solvency II.[25] An example applicable directly to risk margins, is the benchmark confidence levels that have been used in Australia.

[24] Hitchcox, page 6-7

[25] Solvency II is attempting to construct models that separately evaluate the different risks on a line by line basis. Other regulatory capital schemes are not at that level of detail. Care is required in determining whether capital applicable to the selected risks can be obtained from results of solvency models.

2) Results of these methods, particularly quantile methods such as conditional tail expectations and multiples of standard deviations, and capital in the cost of capital method, can be dependent on the estimated effect of extreme events that may not be represented in the available data. This is a problematic area where regulatory or professional guidance on the type of extreme events to be considered and methods of treatment would be helpful to achieve consistency.

With respect to the cost of capital method, one helpful development is that entities and regulators are increasingly relying on models to measure risk. For example:

- The CRO Forum has undertaken a benchmarking study between its members indicating that there is high level of consistency in the models used by its member entities (CRO Forum (2005)).

- The IAIS has developed a principles based paper on internal models (October 2007);

- The IAA, at the request of the IAIS, is developing a paper on the assessment of internal models, with a recent draft (October 2007) issued prior to its public exposure; and

- Standard & Poor's has issued a paper in the assessment of internal models in use by entities rated by S&P.

Source of risk distributions

The examples shown earlier in these sections are based on theoretical curves. In practice, risk distributions may be partly based on methods including the following:

- curve fitting,
- stochastic modeling,
- weighted averages of possible scenarios of relevant extreme events (usually those not reflected routinely or at all in the available data), and
- judgmental analysis of particular operational or risk issues (e.g., new claim or underwriting systems or procedures).

Moreover, the examples assume that estimates of probabilities of all outcomes have been developed. In practice, a complete distribution may not be necessary. For example, there are statistical methods for estimating moments from the data without a deeper knowledge about the risk distribution. Also, it may be sufficient to have only the probability of events at specified probability levels. Stress and scenario testing might be used to provide information on the events at the required levels of probability.

Professional judgment will be required to determine the appropriate approach.

Moreover, to the extent practical the risk of model error would also be reflected. There are some techniques for addressing this risk, but it remains a matter of ongoing research.

6.10.1 Practical issues with quantile approaches

In applying the quantile approach several practical issues can arise.

1. The selection of the level of confidence to apply. While practice has developed in some countries, no theory or practice has yet developed to determine what confidence or CTE level would relate to transfer values.

2. As shown in the examples, it might be appropriate to use different confidence levels for different products. Note that there is yet to develop an appropriate methodology for a specific overall confidence level; varying the levels chosen by product only emphasizes this difficulty. In addition, defining different confidence levels by product may makes it quite difficult to achieve global consistency.

3. During the course of claim runoff, the risk distribution may become 'wider' and increasingly skewed, i.e., there are fewer claims and the remaining claims may be larger. As a result, as with differences by product, to maintain a consistent risk distribution by claim runoff year, different confidence intervals by age may be necessary.

The issues described in issues two and three above may be partially resolved by the use of CTE rather than confidence level targets.

6.10.2 Determining the "cost" in the cost of capital method

Implementing the cost of capital method requires determination of the 'cost' of capital from the perspective of the transferee. If a reference entity is not used, cost will depend on the financial condition and rating of the reporting entity. The financial rating will depend, all else being constant, on the amount of capital in the entity.

In practice, differences in the cost of capital based on financial rating may not affect the risk margin if the capital levels and cost of capital levels are selected on a consistent basis. For example, Table 6.7 in Section 6.5.2 showed that in the selected examples, the risk margin is not significantly changed because the reduction in the cost of capital for a more highly rated insurer is largely offset by the increase in capital required to become more highly rated.

In any case, the cost of capital for a base level of capitalization is required for the cost of capital method. While data on market returns appears to be readily

available, it is not generally in the form needed to calibrate a cost of capital model.

The cost of capital for the cost of capital method is the before-the-event target intended to produce a desired after-the-event pre-tax return on the capital.

It does not refer to the firm's cost of capital, but rather to the market's (e.g., a reference entity's or capital market participants') requirement for return on the capital needed for the unhedgeable risks. This might be determined in a number of ways, including:

1. Judgment. Judgment is useful for testing the reasonableness of the results, but not a desirable source of information for calibrating models to be used for financial reporting. Historical return data might be collected, but these would need to be calibrated to current financial conditions.

2. Analysis of historical returns on book value.

3. Market value analysis. Market value analysis appears to be what commentators have in mind in discussing a market-based approach in a cost of capital analysis. Two issues are evident. First, what is the cost of capital required by external markets based on the market value of the reference entity? Second, what is the internal return on capital that the reference entity must target to achieve the market cost of capital on market value?

   There are a number of well-known methods for establishing the first value, the market cost of capital. The capital asset pricing methodology (CAPM) is perhaps the best known. Other methods include the arbitrage pricing model (of which the market consistent pricing model is one variant), multi-factor versions of CAPM of which the Fama-French 3 factor method (FF3M) is perhaps the most well-known, and discounted cash flow (DCF) methods.[26] Unfortunately, the results of the three methods can, and often do, produce different values of cost of capital from the same data.

   A market based cost of capital then needs to convert the investor expected return on market value into an internal return on capital for the reference entity. The issue is discussed in depth in Hitchcox (2006) and Swiss Re (2005). As with the cost of capital analysis, results vary.

This report does not contain a recommendation concerning the proper level of cost. Rather, its examples are for illustrative purpose only, using costs that have been used by others for this purpose. Observations regarding the cost of capital follow:

[26] Cummins, J.D., & Phillips, R.D. (2005)

1. Sources of information on the value for the cost of capital include business judgment, history of returns on book value, and market analysis.

2. The cost of capital is not the same as the after-tax return on market value that is sometimes determined from methods such as the capital asset pricing method (CAPM). The market cost of capital must be adjusted to produce values relevant to the cost of capital method, which does not reflect the individual firm's cost of capital and its franchise values (market value minus financial statement reported capital).

3. Recent literature on market cost of capital, including converting the market cost of capital into pre-tax return on book value, includes Feldblum (2006), Cummins and Phillips (2005), Hitchcox (2006) and Sigma (2005). Note that these models generally reflect the firm's cost of capital and its franchise value (the value associated with future books of business).

4. Whatever the standard for determining cost of capital for a particular insurance entity, the appropriate method of converting that for purposes of a reference entity used for modeling the risk margin to be used for financial reporting needs to be established.

Various interested parties, including the IAA, have volunteered to assist in efforts to help determine an appropriate method for establishing cost of capital for purposes of determining the risk margin. The RMWG encourages these efforts.

However, in conducting this work, it will be important to consider that the cost of capital might vary from product to product.

6.11 A qualitative comparison of various risk margin methods

This section compares the various risk margin approaches described in this paper against a number of desirable characteristics (tests).

- Compliance with five IAIS guidelines
- Compliance with additional RMWG guidelines
- Ease of calculation
- Market consistency to the extent practical
- Earnings criteria
- Consistency between classes of business
- Consistency with regulatory solvency and other objectives
- Consistency with IASB accounting objectives

The following comparisons are based on the approaches as they would be applied without simplification or approximation. At the end of this section we discuss how simplifications and approximations might affect the comparison of the methods.

The tests are considered one at a time. In each section below, the strengths and weaknesses of each of the methods relative to the one test are discussed. To summarize this discussion we rank order the methods based on the discussion at the end of this section. In this discussion and ranking we considered the methods as they might apply without detailed tailoring and how well they would apply across a variety of jurisdictions. The methods might be tailored to fit particular contexts, and in that context perform better than indicated by the rankings.

It is beyond the scope and not the intent of this paper to select a single method. Therefore we do not attempt to 'rate' the criteria more precisely. For example, we did not attempt to quantify whether the difference between '1' (best) and '2' was large or small; the difference may be large in some cases and small in other cases. We also did not determine relative weights to apply to various criteria. In addition, we recognize that this ranking is not unique or universal as some of the ranking is subjective, based on personal experience with the methods.

6.11.1 Complies with the five IAIS guidelines

The five tests, from Section 6.2, labeled (a)-(e) are repeated here for convenience:

a. "The less that is known about the current estimate and its trend; the higher the risk margins should be
b. Risks with low frequency and high severity will have higher risk margins than risks with high frequency and low severity
c. For similar risks, contracts that persist over a longer timeframe will have higher risk margins than those of shorter duration
d. Risks with a wide probability distribution will have higher risk margins than those risks with a narrower distribution
e. To the extent that emerging experience reduces uncertainty, risk margins will decrease, and vice versa."

We consider the tests individually as illustrated in section 6.5.

Only the cost of capital method would generally satisfy all five tests. Tests (a), (b), (d) and (e) require that the risk margin increase as the risk distribution becomes 'wider' and/or more skew. Section 6.5 showed that this is the case for the cost of capital method. Test (c) requires that for two products with the same risk distribution, the product with a longer settlement period will have a larger risk margin. This is also true for the cost of capital method because the cost of capital risk margin will be the sum of risk contributions over a longer period.

All of the quantile methods fail test (c). Consider two products that have the same risk distribution for unsettled policy obligations at the reporting date, but have obligations that involve settlement over two different time periods. Based

on confidence level, CTE, number of standard deviations, or any method that relies only characteristics of the risk distribution, the two products will have the same risk margin. Test (c) however requires that the product with longer settlement obligations have a larger risk margin.

In addition, the confidence level method does not necessarily satisfy tests (a), (b), (d) and (e). In Section 6.5 we showed that very skewed distributions, e.g., Product D, can result in negative risk margins, as increasing skewness is accompanied by a decreasing rate of increase in risk margins. More generally, the examples also show that as distributions become more dispersed and more skewed, the risk margins implied by a fixed confidence level include fewer standard deviations. This violates the spirit of test (a), (b), (d) and (e) throughout and the letter of those tests in the extreme.

CTE and methods based on multiples of standard deviation generally satisfy tests (a), (b), (d) and (e) better than does the confidence level method. Table 6.2 showed that the CTE method and multiples of standard deviation methods are consistent for the more well-behaved products (A-C), but that the use of CTE is more sensitive to increasing risk than is multiples of standard deviations. However, while CTE is more sophisticated in that it can provide a better insight into the tail amounts, its general approach is similar to that of confidence levels.

Discount methods satisfy test c directly. The methods would satisfy the other tests only to the extent that interest rate risk adjustments vary by product and settlement duration. Discount methods have not been applied in that way in the past.

Explicit or implicit assumptions could be constructed in a manner to address the criteria, but do not necessarily satisfy any of the methods. Each product would need its own set of assumptions.

While each of the methods could be adjusted or combined with other calculations to better fit the criteria, a comparison of the methods if applied in a straightforward manner across multiple products can be summarized as follows:

Table 6.12.1 Comparison of risk margin methods
Test = Complies with the five IAIS guidelines

Issue	Cost of capital	Quantile & moment Methods	Discount	Explicit assumptions
Complies with IAIS guidelines (a), (b), (d), (e)	1	1 for CTE & std dev 2 for %-ile	3	Unknown
Complies with IAIS guidelines (c)	1	3	2	4
Overall	1	2	3	4

1=best; 4=worst

6.11.2 Complies with additional RMWG guidelines

The first two tests are:

"1. Applies a consistent methodology for the entire lifetime of the contract;

2. Uses underlying assumptions consistent with those used in the determination of the corresponding current estimates;"

All four methods can be applied based on a consistent methodology for the entire lifetime of the contract. Moreover, to the extent that each of the methods utilizes assumptions relevant to current estimates, they would be implemented in a manner consistent with emerging experience as the experience affects the current estimates.

The next two tests are:

3. "Is a consistent with other financial contracts; and

4. Where possible, be determined in a manner consistent with accepted economic and actuarial pricing methodologies."

The cost of capital theory measures risk (expressed as required capital) at the reporting date, measures how that risk declines over time, and applies a capital charge for the cost of holding that capital. This is a framework that is familiar to banking and to major investment decision making in all industries.

Moreover, the cost of capital method is also a common actuarial pricing methodology.

Some quantile methods are used in pricing, but not typically outside of insurance.

Risk adjusted discount rates are used to price some insurance products.

The final test is

5. "Facilitates disclosure of information useful to stakeholders."

The minimum level of likely disclosure would be the amount of risk margin and the basis for deriving that amount. Any approach other than implicit assumptions would allow for the minimum disclosure.

For the other methods, the methodology chosen and the key parameters in the calculations would be disclosed. Note that it is always a challenge to describe actuarial methods and parameters in layman's words; however, there is no method for which such disclosure would not be possible.

Table 6.12.2 Comparison of risk margin methods
Test = Complies with additional RMWG guidelines

Issue	Cost of capital	Quantile & moment methods	Discount	Explicit assumptions
Complies with additional RMWG guidelines (1), (2)	1	1	1	1
Complies with additional RMWG guidelines (3), (4)	1	2	3	4
Disclosure	1	1	1	1

1=best; 4=worst

6.11.3 Ease of calculation

Regarding the ease of use of a calculation benchmark, we describe the mechanical application of formulas or the use of models that require no judgmental inputs as 'easier' than methods that require judgment in addition to calculations. Methods that require less simulation of future results we also characterize as easier than methods that require more extensive simulation of future results.

First, consider the cost of capital method. At each reporting date we need to determine the required capital levels both at the reporting data and at each subsequent reporting date. For the first year we need "n" estimates of capital at various projected dates. For the second year we need "n - 1" estimates of capital, and so on. In total, over the course of the runoff we need $(n^2 + n) / 2$ distributions. If it takes 10 years to settle all the obligations, we need to determine 10 risk distributions in the quantile method and 110/2 or 55 risk distributions in the cost of capital method.

Moreover, the methods of determining of the 'cost' in the cost of capital method have not yet been well established. It would be easy if the cost, for regulatory financial reporting purposes, were determined by regulation, as was done for the Swiss Solvency Test, or if the cost did not require routine adjustments. On the other hand, it might involve extensive calculations and application of judgments. In addition, the 'cost' in cost of capital for regulatory financial reporting, if the value is specified by the regulator is not consistent with what the market would require, might not be suitable for general purpose financial reporting

Next consider the quantile methods. In that family of methods, at each reporting date we need to estimate the quantile or moment information only at that reporting date. The release of risk over time is not considered in the quantile method. If it takes n years for obligations to settle, we will need "n" (one for each year for year-end reporting purposes) estimates over the course of the runoff. Although it is simply mechanical to run a model n times, it may take significant time to develop n number of confidence levels to reflect the risk in each period adequately.

Risk adjusted discount rates could be easy or more difficult, depending on the detail involved in the risk adjustment.

Although explicit assumptions could be very simple to apply, relatively complex models might be applied to, say, the individual assumptions.

The discussion above is summarized in the table below.

Table 6.12.3 Comparison of risk margin methods
Test = Ease of Calculation

Issue	Cost of capital	Quantile & moment methods	Discount	Explicit assumptions
Ease of Calculation	4	3	2	1

1=best; 4=worst

6.11.4 Market consistency

To the extent market consistency is considered an appropriate objective, it might be interpreted, in part, the same as the two additional IAA RMWG criteria discussed above:

3. "Is consistent with other financial contracts; and

4. Where possible, be determined in a manner consistent with accepted economic and actuarial pricing methodologies."

There is no available information that allows us to determine whether any particular calibration actually produces liabilities close to transfer values. We therefore split our assessment of these criteria between theory and observations as follows:

Table 6.12.4 Comparison of risk margin methods
Test = Market Consistency

Issue	Cost of capital	Quantile & moment methods	Discount	Explicit assumptions
Market consistent- in theory	1	2	4	4
Market consistent- in practice	Unknown	Unknown	Unknown	Unknown

1=best; 4=worst

6.11.5 Earnings criteria

We identified the following four earnings criteria:

a. "Provides up-to-date information about earnings from current business and the difference between expected results at the start of the period and corresponding actual results during the reporting period." (i.e., be responsive)
b. "Is consistently determined between reporting periods for each entity.
c. “Is consistently determined between entities at each reporting date"
d. "Shows earnings that provide users of financial statements guidance useful for making decisions."

We found that these criteria for earnings purposes largely overlapped with the criteria already discussed and we have not separately rated them.

6.11.6 Consistency between classes of business

Consistency for the assessment means the extent that a risk margin method can generate consistent values across classes of insurance contracts with the five IAIS objectives regarding risk distributions. Any method, given enough adjustments, might be capable of being consistent. Nevertheless, the more judgments that are required, the more difficult it is to maintain consistent results.

However, to the extent that capital is assessed on a consistent basis between lines of business, the cost of capital method would achieve consistency for all five of the IAIS tests.

As discussed previously in this section, the results of the application of confidence level methods do not behave as intended according to the IAIS objectives when applied to classes of business with different risk distributions. The confidence level method would need to vary between classes in order to reflect the targeted degree of consistency. However, both the CTE and multiples of standard deviation methods can provide consistency between classes.

Risk adjusted discount rates would be consistent between classes only if the risk adjustment was selected appropriately on a current basis.

Although explicit assumptions could be designed to achieve consistency, this attribute is not automatically achieved through this approach.

Table 6.12.5 Comparison of risk margin methods
Test = Consistency between classes of business

Issue	Cost of capital	Quantile & moment methods	Discount	Explicit assumptions
Consistency across classes of business	1	2 - CTE & std deviation 3 - %-ile	3	3

6.11.7 Summary

To the extent we considered practical, Table 6.13 summarizes the prior discussion by ranking how the methods could achieve the objectives, with (1) = best meets the criteria and (4) = least meets the criteria.

Table 6.13 Comparison of risk margin methods

Issue	Cost of capital	Quantile & moment methods	Discount	Explicit assumptions
Complies with five IAIS guidelines	1	2	3	4
Complies with additional RMWG guidelines	1	2	3	4
Market consistent - in theory	1	2	4	4
Market consistent - in practice	Unknown	Unknown	Unknown	Unknown
Ease of calculation	4	3	2	1
Consistency between classes of business	1	2 = CTE & std dev. 3 = %-ile.	3	4
Disclosure	1	1	1	1

The rankings given in this table are based on an implementation of each of the methods as described in Section 6.5. The rankings in the table would change depending on whether and to what extent simplifications or calibrations based on results from other methods are applied. For example, the cost of capital method might be made easier to implement with a standard capital model and an easy to apply method of release of capital over time. However, such simplifications would at the same time be likely to reduce its risk sensitivity and/or market sensitivity. The explicit assumption and discount methods might be made more risk sensitive and/or market consistent by calibration to cost of capital or quantile results by product. It is not practical to rank all the permutations of approaches.

Some summary observations regarding the comparison of the risk margin methods include the following:

1. In the quantile family of methods, CTE approaches are theoretically sounder than confidence level approaches, with the differences being significant for products with more skew risk distributions. To the extent confidence levels are specified for risk margins or capital measurement in the cost of capital method, these can more appropriately represent minimum capital levels. Regulatory oversight or actuarial practice would apply higher levels for products whose risk distributions are more highly skewed.

2. Explicit assumptions and discount approaches are best considered as useful approximations for implementing a method such as cost of capital or quantiles. Consistency among insurance products and between insurance and other industries is not practical using a pure explicit assumption or discount approach.

3. Of the methods discussed, the cost of capital method (without simplification) is the most risk sensitive and is the method most closely related to pricing risk in other industries. However, in part as a result, it is also more challenging to implement than the other methods.

4. There is currently no market for insurance liabilities that has relevant and reliable prices that would allow any methods to be tested for market consistency.

Some RMWG members believe that, on balance, the cost of capital approach would be preferable from a pragmatic view point, notwithstanding point 4, although some simplification may be warranted until more experience with it has been gained.

Other RMWG members believe that methods simpler than the cost of capital approach should currently be preferred, since any gain in relevance achieved by the cost of capital method does not outweigh calibration uncertainties, the cost of implementation and the resulting complexity.

Other moment methods, utility theory, and hazard transforms have their theoretical and/or practical advantages, but have not yet been sufficiently investigated to determine whether they are suitable methods in this context, so we did not explore them further in this report.

7. Risk Mitigation Techniques

7.1 Introduction

In paragraphs 30 – 33 of the IAIS *Second Liabilities Paper*, the concept of "allowance for pooling of risk" is considered. On pages 4 and 5 of its May 19, 2006 letter to the IAIS concerning the then draft *Second Liabilities Paper*, the IAA raised the somewhat broader issues of "offsetting risk", "diversification" and "reinsurance" in addition to "pooling". In addition, additional risk mitigation techniques include the design of contract features and asset management strategies, including asset / liability management techniques, that provide a sharing of risks with the customer and the management of an insurer's assets in a way to reduce the risks associated with the contractual obligations. We believe that further discussion of how to handle these various risk mitigation techniques in the measurement of liabilities of insurance contracts and in total financial resources is needed. Sections 7.1 through 7.7 contain such discussion.

There is a cost associated with the application of any risk mitigation technique. Although under some current accounting systems the expenses related to risk mitigation are excluded (e.g., excludes the expense of a business combination or transfer in the calculation of a fair value as being associated with the combination or transfer rather than value of the item being valued), note that the cost of mitigation is integral to the mitigation effect and not to the act of mitigation. Thus, it would be appropriate to include the amount charged (whether viewed as a cost or a profit charge) by a transferee for the effect of the mitigation, whether observed or estimated. To the extent that there is uncertainty associated with the cost of mitigation, this uncertainty would be reflected in the risk margin.

In the meantime, it has become apparent that the issue of risk concentration (i.e., the opposite of risk diversification) should be considered at the same time and it is addressed in Section 7.8.

Each issue addressed in this section is discussed from the perspective of the reporting entity for the measurement of liabilities of insurance contracts. If a reference entity is used to determine risk margins, in whole or in part, then it would also be addressed from the perspective of the reference entity. A summary of desirable characteristics of a risk margin as it is affected by various risk techniques is given in Section 7.9.

7.2 Pooling

Pooling is a risk mitigation device used to reduce volatility, i.e., random fluctuations from the mean value inherent in a portfolio of similar contracts. It does not reduce the cumulative risk, that is, the uncertainty with regard to what the mean value is, but it does reduce the expected deviation of the underlying risk from the expectations about that risk, affecting all similar risks in a similar manner. A small insurer or a business unit within a large insurer can lower its

risk due to statistical fluctuation of its results on its insurance contract liabilities by writing additional similar policies. This process is called pooling and is based on the Law of Large Numbers to achieve a greater certainty in confidence in its interpretation of results. A larger number of similar risks can increase the confidence in establishing an expected value from its experience.

Pooling does not impact the current estimate calculation. The expected value per policy for a small group of policies would be the same as the expected value per policy for a larger group of policies, and consequently the aggregate estimate would not be affected. In addition, the risk distribution for the smaller group is wider (i.e., has a larger coefficient of variation) and potentially more skewness than the risk distribution for the larger group of policies. Thus, combining similar risks, or pooling, results in a reduction in the statistical risk per policy (also referred to as process or random deviation risk).

To the extent that pooling refers to the combined treatment of similar insurance risks that are managed together, its effect would be reflected in both the measurement of liabilities for general purpose and regulatory purposes and in the requirements of the total balance sheet.

An open question with respect to pooling is the extent to which a lack of pooling should be reflected and how it should be reflected. This has been the subject of considerable discussion at IAIS committee meetings.

If the objective expressed in the IAIS *Second Liabilities Paper* that "similar obligations with similar risk profiles should result in similar liabilities" is interpreted to mean that a relatively small pool of risks in one insurer should have the same liability value as the same small pool of risks would have inside a larger pool of similar risks in a large insurer, the IAIS may have to consider providing guidance regarding the reference market to be used to reflect pooling in measuring liabilities. This would mean that the total assets required (risk-based capital) would be the amount at which the smaller pool would be reflected. Similarly, larger insurers with larger pools would be able to reduce their capital requirements rather than reducing their liabilities or increasing their assets. In this case, the effect of a smaller pool size in the risk margin would be due to increase in uncertainty associated with the lack of credibility in the experience data.

The objective expressed in the *Second Liabilities Paper* could be interpreted to mean that a similar-size pool of similar obligations with similar risk profiles would result in similar liabilities. In this case, the risk margin for a pool of obligations would reflect the credibility of the actuarial data available, derived either from the pool itself or from other sources that are relevant to the pool.

In contrast, the IASB has currently indicated that if a price for risk can be observed, it should be reflected in the value of liabilities. Therefore, to the extent that the market includes a price for a smaller portfolio, this price would be included in the risk margin. If, however, efficient markets did exist, the

measurement of a transfer price of a pool of obligations would not be relevant. The use of a common reference entity (see Section 6.7 for further discussion) would eliminate the need to reflect the process risk associated with a small portfolio. Further research and discussion may be warranted in this area.

7.3 Risk diversification

A risk or portfolio of risks is diversifiable if a sufficient number of dissimilar risks (with no positive correlation) are available to reduce the fluctuations caused by the risk or type of risk in a diversified portfolio so that the variability of the total portfolio is less than the variability of each component added together.

The IAIS has referred to the consideration of volatility in its Common Structure Paper, paragraph 61: “In a market consistent valuation methodology, technical provisions should be calibrated based on assumptions about the level of diversification of the relevant risk factors which are consistent with those expected to be made by market participants in assessing the value of the portfolio. For example, in the case of underwriting risk this corresponds to the level of concentration of risk which can be absorbed by the market at zero cost; a residual market level of volatility may remain which cannot be absorbed in the market at zero cost.”

Consideration of diversification (including diversification between portfolios) in the risk margin reflects the availability of dissimilar risks in the market, to the extent a market participant could diversify the risk. The rules of the financial reporting system will affect the extent to which diversification should be considered in the measurement of contracts or instruments.

An entity that writes only one line of insurance is called a mono-line entity. There are benefits to this type of entity that might include being perceived as a specialist or in having the expertise to lower costs from losses or in operating costs. However, a mono-line entity does not have the benefit of risk spread between different product lines. By writing different types of risks or different lines of business, an entity can often diversify and reduce the volatility of losses and therefore lower its risk margin. It may be that law or regulation does not permit such diversification, in which case diversification cannot be used in practice, although this treatment is not based on the underlying economics.

When combining different lines of business (e.g. automobile and property risks), the remaining risk after consideration of pooling within each line would be diversified to some extent by the combination of the portfolios. The risk distribution for the policies combined would have a lower skewness and coefficient of variation than the average values for each of the lines. In particular, confidence level risk margins and the required capital for the cost of capital method would be less than the sum of the separate risk margin or capital amounts.

If a financial reporting system does not permit reflection of the effect of offsetting risks (which are discussed in more detail in Section 7.4) in the measurement of liabilities of insurance contracts (i.e., they have to be measured independently), then diversification benefits would not be reflected in measurement, although this treatment is not based on the underlying economics. When considering off-setting risks to the degree to which uncertainty and risk are demonstrably reduced, the treatment of the effect that diversification has across portfolios may still be an open issue. Not reflecting diversification would seem to contradict the use of market prices because, to the extent that market participants are assumed to be well-diversified entities and seek diversification, observable prices would likely reflect such effects.

There is no actuarial reason for excluding diversification benefits in the measurement of liabilities or in the determination of total financial resource requirements. Note that some reflection of diversification is unavoidable, even within a portfolio, as no two exposures are exactly identical. A portfolio of life insurance contracts, for example, will diversify by including a mix of insureds, occupations or regions. As a result, the key issue is the extent of diversification to be recognized and not whether or not it should be recognized.

See Appendix C for a detailed discussion of the theory of diversification and some approaches to measurement.

7.4 Offsetting risks

Offsetting risks is a risk mitigation technique that uses the negative correlation of the uncertainty associated with a second set of obligations or rights to reduce the risk for a first set of obligations or rights. It can be distinguished from diversification by inclusion of negative correlation.

A special case is hedging, referred to as offsetting that is achieved with a completely negatively-correlated risk (one with a correlation of negative one). Although derivatives are often specifically designed to completely offset a certain risk, derivatives do not refer explicitly to the effect of the risk to the reporting entity, but rather to something external to it, such as an index. Other typical examples are reinsurance and any form of risk-retransfer to policyholders (e.g. participation features), which are discussed in section 7.7. However, such special cases have the additional feature that the offsetting item is directly linked to the effect of the offset risk to the portfolio, thereby effectively eliminating a part of the risk otherwise born by the reporting entity. The offsetting risks discussed in this section exists where there is no direct linkage, i.e., that does not necessarily need to offset each other.

A well-known example would be whole life insurance contracts and whole life payout annuity contracts. The level of mortality for life insurance is different from the level of mortality for life annuities, reflecting both selection and anti-selection. However, the trends in mortality for insured lives and annuitants are highly

correlated; thus a trend in mortality usually affects the other in the opposite direction. An insurer that underwrites both life insurance and life annuities will have less uncertainty and experience less volatility in its overall results than an insurer that issues only one of these types of insurance products.

For the measurement of insurance liabilities, two alternatives exist regarding the impact on liability values from risk mitigation. The first is to ignore any risk mitigation effects in the measurement of the respective liabilities. The second is to reflect a reduction of volatility in each set of risk margin calculations for insurance and annuity liabilities.

The IASB's current *Framework* seems to imply that effects at a higher level than the level of similar risks that are similarly managed should not be reflected in the measurement of the liability. The argument for this is that the effect of off-setting risks would not normally be reflected in transaction prices by market participants. Treated in this manner, it would be reflected only as a reduction in capital requirements. Note that this view is not shared by all observers.

However, if it were determined that this off-setting of risks would be expected to occur in market transactions, it would then be appropriate to reflect off-setting in the reference entity in the application of the cost of capital method of the determination of risk margins. If there is a good hedge available for the risks inherent in a tranche of insurance policies, then the lowest bidder for the liabilities would be expected to be an entity that could make use of them as a hedge, so this is entirely appropriate. In other words, for this particular purpose, the reference entity is an entity that can make use of the tranche as a hedge.

7.5 Reinsurance

In the current version of IFRS 4, the IASB decided that the appropriate accounting treatment for reinsurance was not to present the liability of insurance contracts net of the related reinsurance asset; but rather to present the liability for the direct written obligations and the corresponding reinsurance asset separately.

The preliminary views of the IASB as indicated in paragraph 219 of its Discussion Paper (2007) are as follows:

"The Board has reached the following preliminary views:
- (a) Reinsurers should measure reinsurance liabilities at current exit value.
- (b) Cedants should measure reinsurance assets at current exit value.
- (c) For risks associated with the underlying insurance contract, a risk margin typically:
  - (i) increases the measurement of the reinsurance asset.
  - (ii) is equal in amount to the risk margin for the corresponding part of the underlying insurance contract.
- (d) The current exit value of reinsurance assets incorporates a reduction for the expected (probability-weighted) present value of losses from

default or disputes, with a further reduction for the margin that market participants would require for bearing the risk that defaults or disputes exceed expected value. This is an expected loss model, not the incurred loss model required by IFRS 4 and IAS 39.

(e) In principle, a cedant should recognise at current exit value its contractual right, if any, to obtain reinsurance for contracts that it has not yet issued. However, the current exit value of that contractual right is not likely to be material if it relates to insurance contracts that will be priced at current exit value."

The issue can be simply illustrated. Consider the simple case illustrated above of the insurer writing life insurance contracts up to $5,000,000, but retaining only $50,000 on each contract. The block of reinsured insurance contracts will have a reasonably "well behaved" probability distribution. The block of retained contracts will also have a "well behaved" probability distribution, although it will typically be slightly less "well behaved". The direct-written block of business will have a longer-tailed probability distribution. The question is whether separately calculating the risk-adjusted reinsurance asset and the risk-adjusted direct liability separately will produce an appropriate balance sheet effect.

Both the IASB and the IAIS appear to have recognized the desirability of incorporating risk margins that directly reflect the term and tail[27] of the risk assumed.

It is theoretically possible to determine the pools underlying the direct insurance liabilities and corresponding reinsurance assets independently, ignoring any risk mitigation effect. However, the IAIS and the IASB are expected to propose that the risk margin for the reinsurance asset be measured in a manner consistent with that of the corresponding direct insurance liability. The risk margin for the reinsurance asset would be equivalent to the risk margin for the reinsured portion of the liability for the directly written insurance exposure. This then would increase the asset. Such an approach is well suited for the determination of the total financial resource requirement of an insurer. The risk margin can be calculated separately for the gross and net of reinsurance position of the insurer, with the difference representing the risk margin of the reinsurance asset, or for the net and ceded portions. This is more fully discussed in the IAA International Actuarial Standard of Practice, *Accounting for Reinsurance Contracts* (2007).

7.6 Contractual features related to assets and asset management

A contract feature in a pure unit-linked (variable) contract that is relatively rare is an individual account whose amount is equal to the value of a designated set of assets. Additional benefits are usually provided in these contracts, particularly performance guarantees (e.g., involving level of death benefits, investment return, income and withdrawal benefits) related directly or indirectly to the

[27] Term and tail are words used throughout this report and not words that have appeared in IASB or IAIS literature in respect of risk margins.

account value. The account value can be viewed as being a component of the contract that might be bifurcated, although expected future management fees as well as the guarantees are based on the account value. By forming this account, the insurer's investment return risk is effectively transferred back to the policyholder, whose fund the insurer manages. The policyholder's account value is a proportional share of the total value of the designated set of assets. However, other, sometimes quite significant risks, arise as an indirect function of the investment achieved (in fact, the insurer normally charges for these benefits as a function of the current account value), so it cannot be said that the insurer has transferred all of the investment risk. Although no risk margin is needed for the investment return itself, the insurer would hold potentially very significant risks through the other contract features.

In other types of insurance contracts, the contract obligations are not as directly linked to a set of assets, although a designated set of assets can be allocated to a portfolio that may not be directly allocated to individual policyholders in a proportional manner. These contracts are referred to as participating contracts; in some cases, the share by shareholders, if any, in the generated surplus generated by these contracts are limited, usually as a specified percentage. In exchange for that limitation of profits, they are provided a cushion against risk, usually in the form of a premium schedule whose early payments are greater than would have been charged without this contract feature. There is a wide range of participating features around the world. Other contracts have features that limit the insurer's risk through, for example, non-guaranteed elements.

A range of risk mitigation methods are available to reduce the insurer's risks. Those involving the management of assets are briefly described in this section, while others relating to contract performance are discussed in section 7.7.

An important risk mitigation method used by insurers for non-linked contracts (both insurance and investment) involves what is referred to as asset/liability management strategies and techniques. The objectives of these strategies are to reduce reported mismatches between the assets and liabilities and to ensure that they are managed in a consistent manner to reduce investment losses, reporting variability and liquidity risks. To the extent that they are managed successfully, insurer losses will be mitigated. In general, the expected results of these strategies and techniques are reflected in capital, rather than in the measurement of liabilities. For further discussion, see Section 5.4.

7.7 Contract adaptability features

Many insurance contracts, in some markets practically all life insurance contracts, include features that permit the insurer to modify the cash flows otherwise due after issue in response to subsequent experience. This may apply to either or both cash inflows and outflows. These features include policyholder dividends and bonuses, contract charges, fees, credit interest and adjustments to premiums and contractual benefits. In some cases the contact features may

involve amounts payable to people other than policyholders; profit commission is an example.

The modifications can have a direct contractual relationship to subsequent experience or can be subject to considerable discretion. Discretion can be limited as a result of initial or subsequent contract illustrations provided to the policyholder, dividend resolutions by the entity's boards of directors, regulatory approval or competitive pressures. It could be debated whether or not the amounts not guaranteed by contract or law should be categorized as a component of the current obligation, depending on the financial reporting system. They may, for example, be treated as a constructive obligation. The preliminary view of the IASB is that liabilities should be based on the amounts an entity has a legal or constructive obligation to pay; under this view, amounts expected to be paid but are subject to the discretion of the insurer would not be considered in the liability for general purpose financial reports. The IAIS does not favor the application of such a strict recognition principle. Any expected cash flow would recognize the expected amounts to be paid.

These features can provide the insurer with risk mitigation tools to reduce its contractual risks. In some cases, the original risk transferred to the insurer is re-transferred to a pool of policyholders. These features can reduce the risk margin compared with the risk margin for similar contracts providing identical benefits without the possibility of an adjustment, although in some cases the retained risk might, since more concentrated, be more complex and larger on a unit basis.

Risk margins on a net of ceded reinsurance basis reflect the risk retained by the insurer (as well as by a reference entity that would be transferred the obligation that would include these features) from a contract or a portfolio of contracts, and are determined based on the volatility of the cash flows remaining after all contractual features are reflected. If risk margins were initially determined as if there were no mitigation or risk retransfer features in the contracts, then reductions to the risk margins would be needed to reflect the expected effectiveness of these risk mitigation tools. Since these techniques are part of the same contract, off-setting of rights and obligations would be allowable.

The complexity and wide variety of such features can result in significant measurement issues.

In some jurisdictions, insurers retain the amount of realized surplus for some time for the future benefit of policyholders. Under IFRS recognition guidance, such amounts may be included in current obligations, although in certain cases they would be included in capital. In some cases, flexibility regarding payment of less than current indications exists. To the extent that the risk to the insurer is reduced as a result, the risk margin for these insurance contracts would also be reduced; if reflected, this flexibility would affect the risk characteristics of the insurance contracts (see section 8.3). An example is that in certain jurisdictions

the amount of accumulated surplus can be released to cover losses in an emergency situation, e.g., in event of a threatened bankruptcy,

The binding force of these features might result from such sources as contract terms, applicable law, regulatory action, or fiduciary position. In some circumstances, the distinction between an obligation to pay amounts and discretion can be quite blurred. Insurers often act as if required to do so, without testing the extent to which an obligation exists, legally or otherwise, especially if the obligation might be based on views of the regulatory authority. In case of regulatory reporting, such binding force might be easier to identify and quantify than in general purpose financial reporting, since regulatory requirements can be identified and actions anticipated. If the actual obligation forces the entity to forward parts of the surplus generated to policyholders, but grants the insurer the option to charge exorbitant premiums or even to retroactively adjust premiums or benefits, this reduction in the ultimate risk would be considered for measurement for both general purpose and regulatory financial reports.

Benefits associated with contractual features that are less strictly related to surplus and are significantly subject to insurer's discretion can be assumed not to be paid in highly adverse situations. In such cases, such benefits, although expected to be paid in the normal course of business, may not be reflected as part of liabilities. Past contributions to surplus still subject to future discretionary distribution decisions are reflected as overall available resources. Such features need to be distinguished from performance-linked features that can also provide allocated past surplus that might be subject to future performance that is not yet irrevocably allocated.

The preliminary view of the IASB is that the reporting entity should reflect its best estimate of those benefits it has a legal or constructive obligation to pay. Whether to recognize such benefits may cause a conflict between the principle that only present obligations result in a liability and that a realistic view of the future should be taken. This conflict may involve whether an economic trigger of such payments can be used, e.g., the competitive situation. Ignoring discretionary but expected benefits in the measurement of the liability for the contract may result in reporting profits prematurely prior to the corresponding dividends expected to be paid.

The measurement of such features depends on their nature. They range from obligations expressed as a specified amount determined by a formula based on current performance to those granted on a basis not directly related to current performance of the insurer. In between these two extremes, amounts might be determined by reference to an external index, the accumulated surplus or deficit arising from a group of contracts or expectations raised by benefit illustrations, for example. In some cases, such as term insurance sold at premium levels far less than the maximum guaranteed (the maximum of which might have been set to avoid holding additional regulatory liabilities), the difference may not be expected to be charged in the future; if they were, not only would significant

shock voluntary terminations occur, but the entity's franchise value would suffer as well.

If an adaptability feature contributes additional risks to contract performance, it would result in an increase in risk margins. However, in most cases, the existence of a contractual right by the insurer to make use of a contract adaptability feature to reduce or not to pay a policyholder dividend or otherwise might decrease the uncertainty associated with expected net cash flows which in turn would reduce the risk margin.

The measurement of those features that directly link to the performance of the insurer apply in a manner similar to reinsurance, requiring measurement to be consistent with the linked performance to avoid double counting of risk margins and accounting mismatch. For example, in case of benefits directly determined by the value of investments held by the insurer, the linkage would be measured at the carried amount of the investments. That also applies if the benefits are directly linked to the performance of the insurer. The obligation in that case is triggered by the emergence of a sufficient amount of surplus and would therefore be recognized on that basis. However, in some jurisdictions additional benefits can be provided that are not directly linked to performance, but rather triggered by other reasons, e.g., the competitive situation. In these cases, the benefits triggered by events prior to the reporting date are reported on a probability-weighted basis.

7.8 Risk concentration

Risk concentration, e.g., based on the geographic location of the risk for many insurance coverages, is an important risk consideration for insurance entities, especially where there is potential for weather-related losses such as hurricanes, earthquakes, or tsunamis or a potential for large losses resulting from terrorism or from changes in a judicial ruling that impacts only one geographical area. By writing policies over larger geographical areas, the risk of one single loss event impacting all of the policies would be lower. The impact is that the current estimate of losses will be more certain and the entity’s risk margin would be lower.

However, there are still some remaining issues surrounding the estimations and how potential large losses should be recorded. In its *Blue Book*, the IAA indicated that capital and surplus would be used to absorb the effect of “catastrophes” and great degrees of uncertainty. However, the question remains as to what is significant enough to qualify as a “catastrophe”.

The IASB does not allow what in some countries were referred to as 'catastrophe liabilities' or 'equalization liabilities' to be recognized as liabilities, i.e., amounts aggregated in years without catastrophes to cover losses from future catastrophes. Such amounts do not reflect an obligation as such a provision simply would be an accumulation of past premiums and do not bear any

particular relation to the future expectation of risks. This amount typically was available to smooth earnings, recognizing a portion of a past premium as a future "smoothing" liability that could be used to offset the effect of a future catastrophe. However, to the extent that the risks associated with an unexpired term of the insurance obligation are related to the risks associated with an unexpired period of the insurance obligation, its expected value would be reflected in the measurement of a liability.

Risk diversification and risk concentration should be treated similarly in the measurement of insurance contract liabilities.

7.8 Risk mitigation – desirable characteristics of risk margins

Section 6.2 contains numerous desirable characteristics of risk margins. To summarize the conclusions reached in Section 7, the following additional characteristics also apply regarding the impact from risk mitigation techniques:

- To the extent that the expected experience of a portfolio is uncertain due to the effect of a lack of credibility (amount) of the observed experience, the risk margin would be larger. As the size of the relevant historical experience increases, there is a diminishing marginal impact on the risk margin.
- As diversification increases, the risk margin would be smaller.
- If risks are diversifiable, risk margins would consider the reasonably observable effect from the view point of a market participant.
- With increased use of off-setting risks, the risk margin would be smaller.
- A portfolio with contract adaptability features would tend to have a lower risk margin than a portfolio without these features.

8. Other Issues

8.1 Service margins

The IASB has proposed that the liability for insurance contracts include a margin for services provided by an insurer not related to insurance risks in addition to the current estimate and (insurance) risk margins. Such a margin would represent the compensation required by a third party or a market participant to provide (or arrange to provide) certain services that relate to many insurance contracts, such as investment management services. This can take the form of a fee for the service provided. The stated objective of a service margin is to avoid the front-ending of expected profits for such services. The price paid by market participants would then be considered to include the service margin, along with the current estimate and risk margin.

The elements of the service component of an insurance contract consist of the following:

1. Expected expense (servicing costs). This would be provided for in the current estimates. If observable, this might be a market clearing expense level. However, depending on the accounting requirements, it more likely would represent entity-specific assumptions based on entity strategies.
2. Servicing risk. This risk would be provided for in the risk margin. This includes the risk of contract persistency, the timing risk of the expected expense and measurement uncertainty (associated with estimating the expected value for the contract until derecognition occurs). This element is not different in concept than the corresponding risk associated with other insurance cash flows. This risk is particularly important in an insurance contract in which the contract or claim period is lengthy.
3. The profit portion of the price for which a third party purchaser or provider of the service would charge. This would be provided for in the service margin.

A sense that the size of element 3 might be relatively large is the reason the IASB Board included a margin for services in liabilities in its Discussion Paper. Another motivation is an attempt to treat the service component of an insurance contract consistent with the current approach used in IAS 18, *Revenue*. The problem with this approach is that in most cases its amount in a bundled insurance contract is usually indistinguishable from that of elements 2) and 3) above and from insurance risk incorporated in the risk margin. Although in certain cases a distinct charge for profit may be measurable (e.g., an asset management service provided through a mutual fund with transparent expenses and charges may be explicit, although even in this case the risk margin cannot easily be discerned).

To the extent not observable, it may not be practical to determine or model this charge for profit separately in a non-arbitrary manner. However, it may be possible to reflect this charge for profit in part to the extent that a risk margin can

be determined to provide for it. Otherwise, it may be reflected as part of capital or if a no profit at issue rule is applied, it would be included in the total margin. The IASB staff has indicated that the IASB has not discussed whether the risk and profit elements of the service component may be combined with the risk margin.

According to the current proposal of the IASB as described in its Discussion Paper, if a contract explicitly or implicitly provides a fee for services that market participants typically require, the insurer would recognize an asset and measure it as the amount of the cost needed to originate the contract. If market participants require a larger explicit or implicit service fee, the initial measurement of the asset is less than the origination cost that market participants typically incur (in extreme cases this could be negative, in which case it would be a liability).

Note that the treatment of servicing costs is still open with respect to general purpose financial reporting, as paragraph 62 of the IASB Discussion Paper includes the following: "It should be noted that the if an insurer observes that other insurers incur higher or lower servicing costs than it does, the insurer would need to assess whether the difference arises from differences in the characteristics of the contracts or differences in efficiency. In practice, the Board expects that an insurer would use estimates of its own servicing costs, unless there is clear evidence that the insurer is significantly more or less efficient than other market participants."

8.2 Margins under a "no profit at issue constraint"

This section discusses an alternative role for margins in the context of a different measurement objective for liabilities. At present, the current view of both the IASB and the IAIS toward general purpose and regulatory financial reporting for insurance contracts are based upon exit or settlement values that permit a "profit on issue." However, an entry price accounting objective is still being considered. Alternatively, profit at issue might be prohibited if the associated uncertainties are significant enough. If profits at issue are not allowed to be recognized, a total margin approach, rather than a risk margin approach would be used. In addition, if such a rule is applied, it is possible that insurers will be able to avoid its effect through the use of reinsurance or another form of arbitrage.

One relatively "simple" method of implementing this constraint is to "gross up" the risk margin measured by one of the approaches described in Section 6 by an amount so as to produce a zero profit at issue. Of course, this method might be extended to not allow a loss at issue as well (i.e., a negative risk margin), but that approach is generally deemed to be inappropriate.

Another approach would be based on a risk margin that relates to only one parameter that would be determined judgmentally. In that case, this parameter would be modified so that the resulting risk margin would absorb any initial gain.

The following are possible approaches that could be applied after issue:

- Follow one of the risk margin approaches described in Section 6. This would result in the amount withheld as profit at issue flowing immediately back into profits, which would defeat the objective of the constraint.
- Calibrate the total margin that would have produced the profit at issue. Maintain the assumptions underlying that total margin for calibration purposes at subsequent measurement dates until there is reliable statistical evidence that either the current estimate of the liability has decreased significantly or the probability distribution of the insurance liabilities has become “better behaved". What constitutes reliable statistical evidence is an issue that requires further investigation.
- Calibrate the total initial margin to represent an equivalent confidence level or cost of capital, with subsequent adjustments made only when the price of risk demonstrably changes, consistent with the current entry approach.
- Calibrate the total initial margin, to be worn off on a release-from-risk basis, with the risk margin otherwise calculated being grossed up by a factor equal to the ratio of the initial total break-even margin to the otherwise calculated initial risk margin.
- Calibrate the total initial margin, to be released in proportion to the major profit drivers of the contract, such as is currently used in Australia for life insurance in a Margin on Services approach.

8.3 Credit characteristics of the liability

The purpose of this section is not to discuss whether to directly reflect the credit characteristic of the liability (sometimes referred to as *non-performance risk* or *own credit standing*), but rather to discuss possible approaches to measure this risk if it is required to be applied. The IASB proposed in its Discussion Paper that the credit characteristics of the liability should be reflected in the measurement of liabilities for insurance contracts for general purpose financial reports. The IAIS does not intend to consider such an adjustment for regulatory financial reports.

The first issue to resolve is how to reflect these credit characteristics. If the contract is a financial instrument, it would be logical to apply them through the discount rates, the primary income driver of such an instrument. As significant insurance elements are included, a more relevant approach may to reflect these characteristics as a function of the expected cash flows or even applied separately. However, if applied to the cash flows, then it may also be appropriate to reflect the uncertainty associated with these characteristics in the risk margin.

This is equivalent to considering that the liability cash flows to be valued are not certain to be paid, that is, a risk of non-performance. In practice, of course, the shareholders of an insurance entity do not have unlimited liability. They have no

obligation to put more capital into the business and have the option of "walking away" from its obligations, either voluntarily or if forced to in the case of an inability to replace the exhausted capital. This would result in the amount of policyholder net cash outflows being reduced. Therefore, from a shareholder perspective, at least in theory, the liability cash flows are not certain to be paid in full, and there is a value to the "default option" of walking away from the obligations in very adverse conditions.

The more capital the entity has, the less valuable this option is, and hence the market-consistent value of the liabilities of a strongly capitalized entity or one that has either explicitly purchased or implicitly incorporates (through a state-sponsored guarantee fund for example) protection against particular types of potential catastrophic loss could, in theory, be larger than that of the liabilities of a more weakly capitalized entity.

From a pricing perspective this would mean that, in theory, the price (before inclusion of a profit margin) of the same obligations underwritten by an insurer of high credit standing would be higher than one with lower credit standing. From the standpoint of the more weakly capitalized entity a reduction in price may be necessary in practice to compete for new or to keep existing business, although this is not necessarily an argument for its reflection in the measurement of a liability.

The following extract is from the IASB Insurance Working Group discussion in January 2006.

> Although this topic is often described as relating to the entity's own credit standing, in fact it relates to the credit characteristics of the instrument (i.e., risk of default on the particular instrument). Different instruments issued by the same borrower may have different credit characteristics. In many jurisdictions, liabilities to policyholders rank above most other liabilities: where that is the case, default is *less likely for liabilities to policyholders than for other liabilities.*

In practice, for many regulated insurers, the impact of their own credit standing may be very limited, given supervisory procedures that aim to minimize the possibility of any losses to policyholders. However, in some extreme cases, the impact may be material. For example, catastrophe protection of the types referred to above may be applied if there were to be a pandemic of bird flu or a sudden crash in financial markets, or if an insurer is too important of a financial institution to let fail. A sudden decline in solvency may also lead to a situation where capital markets are no longer willing to supply further capital to the entity in support of its franchise value.

Rating agencies provide Claims Paying Ability ("CPA") ratings specifically aimed at reflecting this small possibility, and would also comment on this in their normal ratings. According to Standard and Poor's, "Insurers rated A+ offer good financial

security, but capacity to meet policyholder obligations is somewhat susceptible to adverse economic and underwriting conditions".

Nevertheless, using these ratings to derive an appropriate allowance for the credit characteristics of the contract or pool of contracts is problematic, for a number of reasons:

- The methodology used by the ratings agencies to derive claims paying ability ratings is not always transparent. It may be based on nothing more than the perceived risk of the month or judgment that is not consistent with that of the market. Although the rating may be based on a quantitative model of the insurer's current capital strength, with little or no allowance for the possibility of future capital being raised. On a "going concern" basis it might be appropriate to assume that shareholders would seek to raise extra capital in case of financial distress, which would reduce the risk of default on policyholder obligations. However, it could be argued that it would not be appropriate to reflect this in the measurement of the liability, but rather in the measurement of needed capital.
- These ratings may present a conservative estimate of the own credit standing for the average insurance obligation if they focus only on losses to the point at which the first claim cannot be paid.
- There is no deep market in policyholder obligations (as there is for corporate bonds) enabling us to observe a credit spread for the liabilities of insurers of different ratings. However, although this implies that there may not be an observable metric to which calibration can be performed, qualitatively it may not be that much different than deriving estimates of credit risk on a modeled basis. Less controversially, such a credit reduction in the liability may be needed to apply to a ceded reinsurance asset.
- The credit spreads on corporate bonds bearing similar ratings may not be an appropriate measure because there may be no direct correspondence between probabilities of default on corporate bonds of a given rating and on the policyholder obligations of an insurer with the "same" claims paying ability rating.
- The most problematic problem that has not yet been fully explored is the regular assessment of this risk. This extent of this assessment would be expected to vary with market risk preference and may then produce far greater volatility compared to what would normally be expected to be infrequent reassessment of the value of the contract's or portfolio's credit characteristics.

It seems evident that the risk of policyholder default should be less than the risk of default on the insurer's debt. However, for the reasons set forth above, assessing the allowance for own credit standing would be difficult.

In summary, the default option does exist and, although entities are not generally managed to exercise it, in extremely adverse scenarios financial statement requirements may lead to recognizing reductions in the value of the liabilities. From a purely theoretical perspective therefore, there is some justification for recognizing these credit characteristics in a market-consistent valuation. In many cases however, the level of allowance is likely to be very small given that the likelihood of the allowance being effective is remote. Also, objectively assessing an appropriate allowance may prove difficult, although banks who are complying with U.S. GAAP SFAS 157 are showing that it can be done. But at the same time certain users are proving that that they are not reflecting the allowance in their financial decision making.

8.4 Operational risk

In the IAA's *Blue Book*, it was assumed that the proper place to reflect operational risk was in the capital and surplus of the insurer rather than in the liabilities of insurance contracts, while the IASB, considering that these operational risks are faced by any owner of such a portfolio, requires them to be considered in the liability for insurance contracts.

During its deliberations, members of the IAA RMWG have expressed the opinion that at least certain aspects of operational risk should be reflected in the liabilities of insurance contracts.

The IAA's RMWG has not discussed this issue sufficiently to take a position. The purpose of mentioning operational risk in this paper is to note that a decision should be made as to where (and how) operational risk should be reflected in order to best achieve consistency between general purpose and regulatory financial reports, as well as to achieve consistency between preparers of these financial reports. Techniques to measure operational risk are currently in an evolutionary state.

8.5 Governance

A discussion of relevant governance issues surrounding the measurement of liabilities for insurance contracts is outside the scope of this paper. Governance issues are important because they encompass the insurance entity controls surrounding every element of the process used to develop relevant measurements. Controls are important to validate the reasonableness of the data and experience studies used, assumptions made, and resulting estimates made.

Even though actuaries may not be responsible for measurement, actuaries are experts who are usually involved in assisting with this responsibility. As such, actuaries need to have transparency in documentation and their presentation of measurement estimates is important.

Appendix A – Statistical Background, Product Assumptions and Risk Distributions Considered for Risk Margins for Different Time Horizons

A1 Coverage and risk distributions

The principal drivers of risk margins using the methods discussed in Section 6 include the time it takes to settle policy/claim obligations distribution (risk distribution) of possible final settlement. Table A.1 shows three patterns of life insurance and three for general (property & casualty) insurance that have been selected for the examples in Section 6.5.

Table A.1 Coverage and runoff periods
Discounted current estimates at the beginning of the year

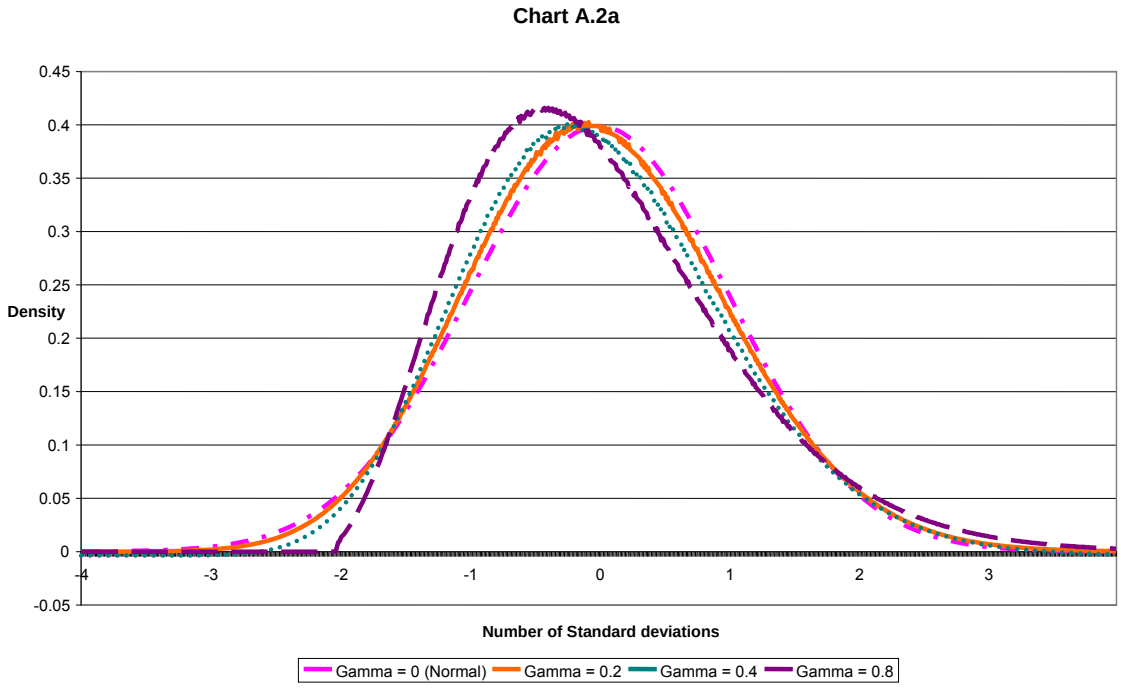
Year	Life insurance			Property & casualty insurance		
	Short	Medium	Long	Short (Property)	Medium (Motor)	Long (Liability)
1	100%	100%	100%	100%	100%	100%
2	50	90	95	50	58	89
3	20	80	90	20	27	77
4	5	70	85	5	6	66
5	0	65	80	0	2	54
6		59	75		0	43
7		53	70			37
8		47	65			31
9		41	55			26
10		35	50			20
11		0	46			14
12			42			11
13			38			9
14			34			6
15			30			3
16			27			0
17			24			
18			21			
19			18			
20			15			
21			13			
22			11			
23			9			
24			7			
25			5			
26			4			
27			3			
28			2			
29			1			
30			1			

We selected four risk distributions that are broadly representative of (a) policy obligations for simple life insurance products, (b) unpaid claim obligations for motor insurance, (c) unpaid claim obligations for risky liability/low risk reinsurance and (d) pre-event cover (associated with premiums not yet earned) for extreme events. These are represented by risk distributions with skewness (γ) = 0.20, 0.40, 0.80 and 8.0, respectively.

The risk distributions for Products A, B and C are represented by compound poison distribution models represented by the normal power approximation with the selected skewness and CV. Those normal power approximations are similar to lognormal distributions with the selected CVs. Section A.5 compares the normal power approximation to the lognormal distribution. Product D uses a lognormal distribution.

Chart A.2a shows the distributions for the several levels of skewness, assuming that there is no difference in standard deviation. This chart shows that the right tail of the distribution gets fatter as skewness increases. This implies that more capital is needed for higher levels of skewness.

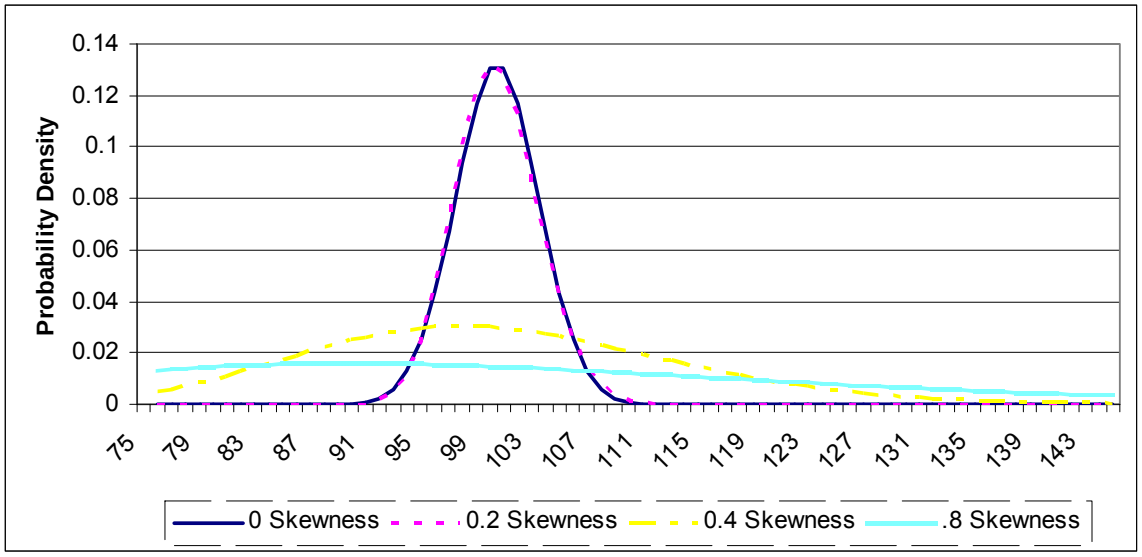
Chart A.2a Probability distribution functions for distributions with gamma 0.0 (normal) and 0.20, 0.40, and 0.80 (Products A-C)



For realistic insurance distributions, a higher level of skewness tends to occur with a higher standard deviation. Chart A.2b shows the equivalent of Chart A.2a with the pairs of standard deviations and skewness levels used for the illustrations in Section 6, when adjusted to have the same mean. The normal

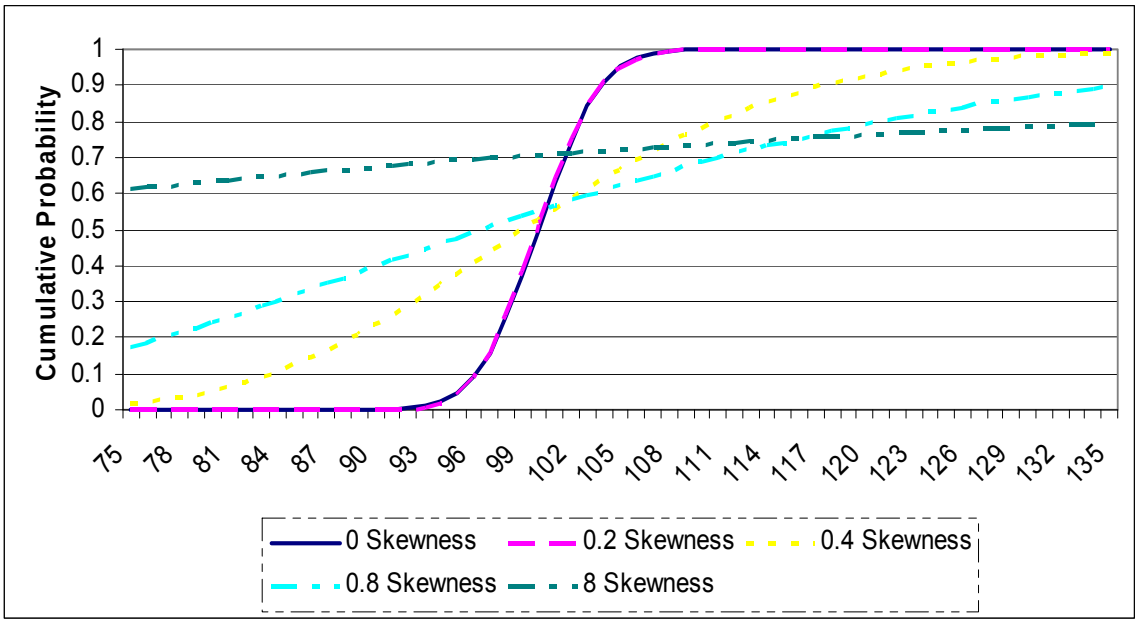
and Product A curves are nearly identical, and cannot be readily distinguished on the chart.

Chart A.2b Probability distribution functions for products A-C



The distribution with skewness 8.0 cannot be illustrated with the previous three distributions without losing information owing to the increase in horizontal scaling. However, Chart A.3 shows the four cumulative probability distributions. The chart includes the normal distribution with the same mean and CV as the 0.2 skewness distribution. As in Chart A.2a, those two distributions cannot be readily distinguished on the chart.

Chart A.3 Cumulative probability functions — various levels of skewness



A2 Conditional Tail Expectation

Section 6.5 showed that confidence at the 65% level, for example, can be less than the mean values for highly skewed distributions and that factor makes them not suitable for risk margins purposes in those cases.

One quantile method that produces results that are similar when the distributions are not skew but avoids the negative risk margins for skewed distributions is the conditional tail, also called the tail value at risk. This is the conditional expected value of a probability distribution given that the loss exceeds a particular quantile.

The mathematical definition is

$$CTE(p) = E\{x \mid x > z(p)\} = \frac{\int_{z(p)}^{\infty} x\, f(x)\, \mathrm{d}x}{\int_{z(p)}^{\infty} f(x)\, \mathrm{d}x}$$

where f(x) is the probability density function, p is the selected quantile and z(p) is chosen so that

$$\int_{z(p)}^{\infty} f(x)\, \mathrm{d}x = 1 - p$$

In words, the CTE is the expected value of those outcomes above a given quantile. For example, CTE 80 is the average, excluding the lowest 80% of possible outcomes.

It is generally anticipated that the 99% CTE level would be similar to a confidence level of 99.5%. For risk margin purposes, the CTE level corresponding to confidence levels of 65% to 90% varies more widely depending on the details of the distributions. In our examples the 60%-90% confidence levels corresponded to CTE levels of 40% to 75%.

A3 Minimum capital requirements and cost of capital formulas

A test for the adequacy of total financial resources could be formulated in several ways. Two of these are described in this section.

Test A -- consistent with the Swiss Solvency Test

- Capital is determined so that at any time during the runoff period there is a sufficient probability (e.g., 99.5%) that assets are sufficient to cover best estimate liabilities and risk margins
- The risk margin is determined from the SST formula used in Section 6.

This can be described by the following formula

$$M_{SST} = (r - i) \sum_{t=0}^{\infty} \frac{C_t}{(1+i)^{t+1}} \qquad (1)$$

where M_{SST} is the risk margin from the Swiss Solvency Test, and

- i = Risk-free rate of return on investments (4% in our examples)
- r = Total rate of return demanded by investors for taking on insurance risk. This is the risk free rate plus an additional cost of capital provision, 4% plus 6% = 10% in the examples.
- C_t = Amount of capital required (or allocated) to support an insurance portfolio at time t.
- t = 0 is the measurement date; t = 1 is the end of the first year, etc.

This test is equivalent to the idea that liabilities could be transferred at any time for a price equal to the current best estimate plus a risk margin.

Test B – sometimes called the capital cash flow calculation (CCF)

- Determine total assets such that there is a sufficient probability (e.g., 99.5%) that the claim payouts will not exceed assets.
- Divide those assets into three parts:
    a. The discounted mean,
    b. a risk margin calculated from the Capital Cash Flow (CCF) formula developed below, and
    c. capital equal to the total assets minus ((a)+(b))

The cash flows in Test B can be described as follows. Assume that Insurer #2 takes on the obligation of Insurer #1. In return, Insurer #2 receives assets equal to the discounted liability plus a risk margin M_{CCF}.

- At the beginning of the first year, at time $t = 0$, investors contribute a sum of C_0 to Insurer #2 and earn a risk-free rate of return, i, over the next year.
- At time $t = 0$, Insurer #2 collects M_{CCF} from Insurer #1 and immediately transfers it to its investors. Equivalently, one could say that the investors contribute $C_0 - M_{CCF}$ to Insurer #2.

  (Note: $C_0 - M_{CCF}$ *represents 'pure' capital and* C_0 represents total assets above the discounted best estimate)
- At time $t = 1$, the investors are obligated to keep C_1 invested in the Insurer #2, and they expect to receive a cash flow $C_0(1+i) - C_1$ at the end of year 1. Since the losses the Insurer #2 is required to pay and C_1 are uncertain, they discount the value of the amount returned at the risky rate of return $r > i$.
- Continuing on to time t, the investors are obligated to keep C_t invested in Insurer #2, and they expect a cash flow of $C_{t-1}(1+i) - C_t$ at the end of year t.

Since the cash flows are uncertain, it is reasonable to discount the cash flow at the risky rate of return, r. This leads to the following expression:

$$C_0 = M_{CCF} + \sum_{t=1}^{\infty} \frac{C_{t-1}(1+i) - C_t}{(1+r)^t} \qquad (2)$$

This equation implies.

$$\begin{aligned} M_{CCF} &= C_0 - \sum_{t=1}^{\infty} \frac{C_{t-1}(1+i) - C_t}{(1+r)^t} \\ &= \frac{C_0(1+r-1-i)}{1+r} + \frac{C_1(1+r-1-i)}{(1+r)^2} + \frac{C_2(1+r-1-i)}{(1+r)^3} + \ldots \qquad (3) \\ &= (r-i)\sum_{t=0}^{\infty} \frac{C_t}{(1+r)^{t+1}} \end{aligned}$$

Test A requires more total assets than Test B for several reasons. First, in Test A capital needs to be sufficient to ensure that assets cover risk margins as well as discounted liabilities during the course of the runoff period. To remain solvent means that assets exceed liabilities (including risk margins), Test A covers solvency through the course of runoff while, under Test B an entity could pass even it were insolvent during some part of the claim runoff.

Second, in Test A the capital needs to be sufficient to cover the risk that liabilities over-state the ultimate payout and create a 'false' projection of failure.

Test B, however, is the way many general insurance calculations have historically been computed.

Application of Test A can be difficult as it requires assumptions about liabilities and details of the payments that cannot readily be done with risk distribution alone.

As a practical matter, the above analysis assumed that required capital is based on Test B, but used the Test A cost of capital formula as if we had determined capital based on Test A. This might overstate our result. Application of the Test B formula, on the other hand would have understated our answer.

Table A.4 Risk margins—SST and CCF formulations

Product	SST/ Test A	CCF/ Test B
A	4.1%	2.9%
B	4.5%	4.1%
C	36.8%	27.7%
D	94.7%	85.9%

The effect of the difference between the tests increases as the time to settle claims/policy obligations increases. We can see this because the difference is proportionately larger for products longer payment periods A and C (about 25%) compared to the products Product with shorter payment periods B and D (about 10%).

A4 Lognormal distribution and the normal power approximation

In Section 6.4 we observed that the normal power approximation and log normal distributions produce similar results. Table A.5 below compares several confidence levels for two distributions similar to the ones used in our illustrations.

Table A.5 Comparison of a lognormal distribution and the normal power approximation at selected skewness (gammas)

Probability	CV = 0.133; gamma = 0.40			CV = 0.261; gamma = 0.80		
	Excess over mean			Excess over mean		
	Lognormal	Normal power approximation	% Diff	Lognormal	Normal power approximation	% Diff
65.00%	.325	.329	1.23%	.261	.272	4.21%
90.00	1.313	1.324	0.84%	1.320	1.367	3.56%
99.50	2.964	2.951	-0.44%	3.350	3.327	-0.69%
99.90	3.703	3.660	-1.16%	4.364	4.230	-3.07%
99.95	4.004	3.946	-1.45%	4.796	4.601	-4.07%

The skewness (gamma) of the lognormal distribution is

Gamma = exp (sigma^2 +2) * (sqrt (exp(sigma^2 -1)

= (3 + CV^2) *sqrt (CV^2)

= (3 + CV^2) * CV

where sigma is the standard deviation of the normal distribution that has been transformed into the lognormal distribution.

Given gamma, we can solve for CV using the following cubic equation,

CV^3 + 3*CV – gamma = 0

For gamma = 0.20, CV=.067
For gamma = 0.40, CV= 0.133
For gamma = 0.80, CV= 0.261
For gamma = 8.00, CV=1.512

These values can easily be tested by use of the formulas and a routine to solve cubic equations as given in http://www.1728.com/cubic.htm.

A5 Risk distributions considered for risk margins - time horizon and changes in risk perception

Section 6.9 discusses the context of risk margins in respect of time horizon and risk perception.

The measurement of liabilities for insurance contracts considers the full range of possible outcomes and hence would need to reflect any change in risk perception that may occur in the future. This section discusses the risk distributions required to achieve that result.

Run-off test

For ease of reference we define Distribution O as an estimate, at the reporting date, of the possible settlement costs by year and associated probabilities of those settlement costs. Distribution O is the distribution most often discussed in the actuarial literature where it is referred to the distribution of ultimate outcomes. Distribution O would allow calculation of the present value of expected payments across the range of possible scenarios. In the percentile approach used by APRA, Distribution "O" would be used, for example, to establish the 75th percentile level, i.e., the amount at the reporting date such that there is a 75% probability that the ultimate cost will not exceed that amount. This distribution, with an assumption about the cost of capital for each year during the settlement period, allows us to calculate risk margins using the cost of capital, method. However, as the 'cost' of capital is not 'known' for each year, then an additional variability needs to be considered. This is discussed in the following paragraphs which also consider the 'Change in Surplus' Test.

Change in Surplus Test

This test requires us to consider possible movements in transfer value of assets and liabilities (e.g., market values) over a specified time horizon, e.g., one year. To assess this movement for liabilities, we define "Distribution M (one year time horizon) as the estimate, at the reporting date, of the possible transfer (or market) values one year hence and the associated probabilities. As Distribution M refers to the transfer value, it includes a market consistent risk margin.

If there was a market in insurance liabilities, then Distribution M could be observed. It would be equivalent to the distribution of changes in observable market prices of financial instruments. As there is no market in which values can be 'looked up', Distribution M needs must be estimated. There are three sources of variation to consider.

1. Changes in the market perception of risk, i.e. changes in the compensation for accepting the same risk required by market participants during that year. This source of variation is like the change in spread between corporate bonds and low-risk government bonds.

2. Changes in expert (e.g., actuarial) estimates of the ultimate settlement values from the amount estimated at the reporting date to the amount estimated one year later. This estimate will change as new information develops. The expected present value of the liability at the reporting date, call that E (1, time=1), would be based on Distribution O_1. However, one year hence we will have an updated Distribution O; call that Distribution O_2 based on one more year of information. The expected present value based on O_2 at time=2 we can call E (2, time=2).

   Usually, E (1, t=1) will not equal E (2, t=2). We call this movement in expected values Distribution E (one year time horizon), which we define as the estimate, at the reporting date, of the possible values of actuarial estimates one year hence and the associated probabilities.

3. Changes in differences between market assessment of possible outcomes and the expert assessment at the end of the time horizon. There would normally be little variation between market and expert views of expected values but market views might vary significantly around actuarial views if developments suggest a 1/100 or 1/200 year event. It is often not possible to distinguish part movements in risk perception, the first factor, and differences in market and expert views of expected values, the third factor.[28] While we

[28] In normal circumstances we might expect market opinion of expected values to be very similar to expert opinion. Also, it can be difficult to distinguish between change in risk appetite and differences of opinion on expected values. In extreme circumstances, e.g., regarding the 1 in 200 year events, prices in a market will likely be volatile. For example, for a period of time after Hurricane Katrina, securities linked to U.S. Gulf Coast hurricanes showed price changes that were larger than expert opinion would indicate. This can be interpreted as risk aversion due to lack of satisfaction with the accuracy of the hurricane

identify this source of variation separately, in practice it might best be considered part of the variability in the perception of risk, the first item.

The change in estimated expected value and change in risk perception would be considered regardless of the risk margin method used. The treatment of movement in estimated expected value is largely the same in all methods. The change in risk perception would be reflected differently in the different methods. For example, in the cost of capital method, a change in risk perception is reflected as a change in the 'cost' component of the method. In a quantile method, a change in risk perception is reflected as a change in the confidence level, number of standard deviations or CTE level required by the market.

Comments

The following three risk distributions have been defined:

1. Distribution "O", the distribution most often discussed in actuarial literature and used in practice.
2. Distribution E (one year time horizon), normally estimated from the projections underlying distribution O and applying formulas relating emerging experience to change in estimates.
3. Distribution M, with three driving factors: (a) Distribution O, (b) movements in estimates of expected values, Distribution E, and (c) variation in market risk perception from year to year.

The following observations relate to the relative size of risk margins implied by these distributions.

- The use of Distribution M (n-year time horizon) in the cost of capital, confidence level, standard deviation, CTE method, or any other method based on the use of risk distribution, will produce higher risk margins or capital requirements than Distribution E (n-year time horizon). This is because Distribution E reflects only movements in actuarial estimates, while Distribution M also reflects movements in (a) market perception of risk and (b) the difference between market perception of expected values and the actuarial estimates, to the extent that movement can be distinguished from (a).

- Comparing Distribution M and Distribution O is more complex. It is useful to consider unpaid claim obligations (general insurance) and policy obligations (life insurance) separately, and to focus on the more adverse scenarios (75% and 99.5% confidence levels) that are required for risk margins and capital assessment.

damage models used to calibrate those securities and uncertainty regarding whether that was really a 1 in 200 year event..

Unpaid claim obligations (e.g., general insurance)

- Severely adverse scenarios might be produced by court decisions, increases in cost levels due to inflation, unexpected increases in number of claims, or poor initial estimates. These factors can quickly change estimates of ultimate values and produce updated estimates that differ significantly from the actual outcomes (as the ultimate effect of 'bad news' can be under- or over-estimated). Thus, Distribution M (one year time horizon) will often include tail scenarios in which it implies higher risk margins than Distribution O. Thus for methods based on parameters from a risk distribution, e.g., quantile or cost of capital methods, the risk margin based on M is greater than the risk margin based on O.

- This relationship contrasts with a possible false perception that use of Distribution O (outcomes) must produce higher capital requirements of risk margins than Distribution M (one year time horizon) because Distribution O is long-term and Distribution M is short-term. That comparison is faulty because Distribution O includes long-term actual outcomes, while distribution M includes the short term market estimates of the long-term outcomes. The market estimates can include more adverse scenarios than the actual outcomes.

Policy obligations (e.g., life and annuities)

- For policy obligations the relationship between Distribution O and Distribution M is less clear. Adverse developments can include increases in mortality (or decreases for annuities), increases in lapse rates and increases in administration expenses. These can be one-year effects or be mitigated by management actions and therefore may have a limited effect on ultimate values, actuarial estimates or market values beyond the observed effect during the time horizon. The movement in market values might be 'slower' than discussed above for unpaid claim obligations. The risk margins based on M-one year time horizon might not be higher than the risk margins based on O. However, over some time period, e.g., 5-years the project market would 'catch-up' and risk margins based on Distribution M (5 year time horizon) would be greater than risk margins based on Distribution O.

Further effort is warranted to develop appropriate professional techniques and standards and regulatory guidance to ensure consistent practice across companies.

Distributions used in the examples in this report

As the examples in the report are presented to illustrate the basic concepts, the examples in this report did not use Distribution M. The examples in Section 6.5 use Distribution O. The examples in Appendix B use Distribution E. These examples assume that Distribution E (one year time horizon) can be reasonably estimated from the modeled data by year. They also assume that the market

value risk distribution over the time horizon is the same as the distribution of actuarial estimates, i.e., Distribution M (one year time horizon) = Distribution E (one year time horizon).

In theory, distribution M would be the appropriate distribution to use. However, note that under a market consistent approach this would not be consistent with the valuation of assets, as these do not include changes in risk perception other than what has already include in the price.

APPENDIX B – Life Insurance and Annuity Risk Margin Examples

This appendix considers an example how to calculate risk margins, based on quantile and cost of capital methods. The models used are based on a simplified internal model.

B1 Example – Risk margins for a single premium payout annuity contract (guaranteed for the whole life)

In this example, the risk margins for single premium annuities whose payout is guaranteed for the whole of life are calculated based on the cost of capital method. The annuities are for a group of 65-year-old males. The calculations are based on a model presented in the *Blue Book* and earlier papers of the IAA Solvency Working Parties and van Broekhoven (2002).

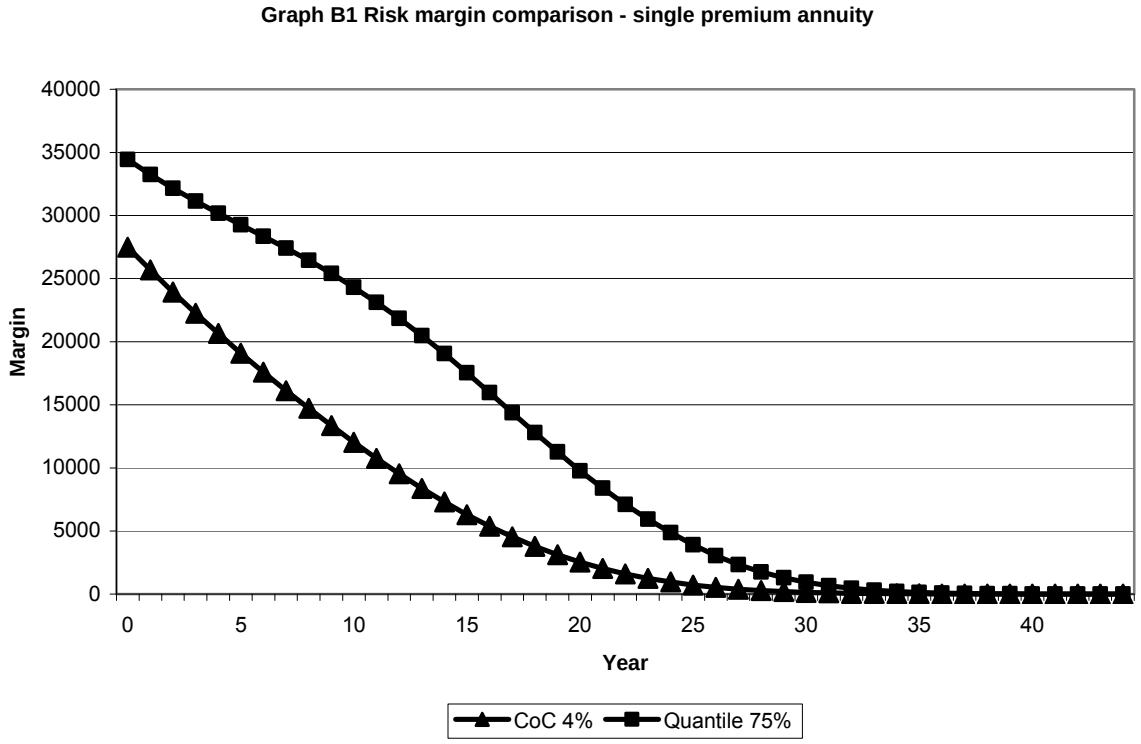
An overview of how the calculations were prepared is given below.

The calculations themselves are relatively complex, but the results for the annuities show that it is relatively easy to determine a simple standard model for the projection of economic capital. The pattern of this capital is almost linear in form. Further investigation is needed to confirm whether this pattern applies to other products as well.

The discount rate used is the risk free yield curve. For this example a constant discount rate of 3.5% is used.

For a AA rated entity, the risk margin for an annuity for 65 year old males is 1.09% of the current estimate for a AA rated entity. The risk margin derived from the 75% quantile method is much higher (1.39%). The primary reason for the difference is due to the approach needed to determine the parameters. It is useful to examine how the risk margins develop as a percentage of the then current estimate over time, as indicated in Graph B.1.

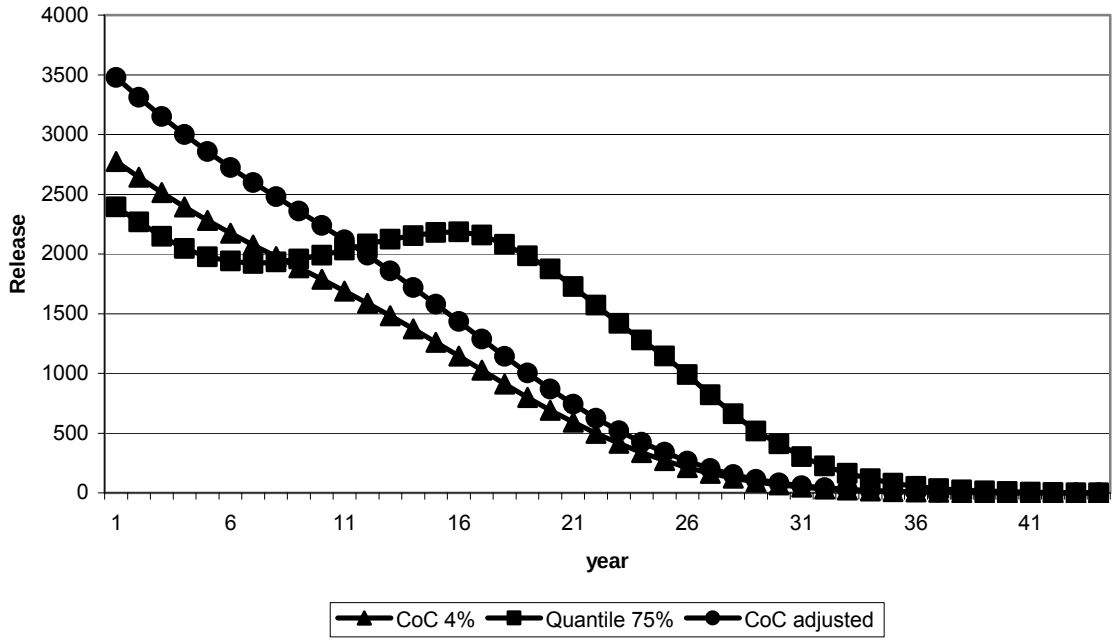
Graph B.1 Risk margin comparison single premium annuity



In Graph B.2 the release of the risk margin is shown, starting at the same level of risk margin for ease of comparison. The initial adjusted result is equivalent to the application of the cost of capital method at a 4.78% discount rate rather than at 3.5%.

Graph B.2 Release of risk margins over time with consistent initial values single premium annuity

Graph B2 Release of risk margins over time; single premium annuity



As can be seen, for this example the release of the risk margin determined by the cost of capital method is more linear over time than that of the quantile method. This is logical because the cost is a constant percentage of the economic capital (EC). Note that the relative shape of the risk margin over time does not necessarily follow these patterns. The quantile method also reflects the effect of the release of the capital itself. In this example the application of the cost of capital method generates greater profit in the early contract years and a smaller profit later, similar to the original smaller cost of capital calculated at 4%.

Detailed results by year for the two methods are presented in Tables B.3 and B.4.

Table B.3 Risk margin based on cost of capital of a AA rated entity single premium annuity

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
				=0.75%(2)	=1%(2)		=4%(7)(j-1)		=(9)/(2)	=(2)+(9)
Marginal impact:		25%	25%	50%	75%			Risk margin		
Year	Liability Current estimate	Stand Alone Trend	Stand Alone Level	Stand Alone Expense	Stand Alone Operational	Total incl. Diversification	Cost of Capital	= PV(3.5%) CoC (8)	=% (2)	MVL
0	2500000	53044	112024	18750	25000	69392	0	27498	1.1%	2527498
1	2379318	46715	110515	17845	23793	66075	2776	25685	1.1%	2405003
2	2258006	41216	108709	16935	22580	62884	2643	23941	1.1%	2281947
3	2136303	36658	106647	16022	21363	59860	2515	22263	1.0%	2158566
4	2014454	33126	104332	15108	20145	57027	2394	20648	1.0%	2035103
5	1892734	30599	101743	14196	18927	54379	2281	19090	1.0%	1911824
6	1771461	28940	98840	13286	17715	51874	2175	17583	1.0%	1789043
7	1650977	27912	95673	12382	16510	49470	2075	16123	1.0%	1667100
8	1531655	27264	92195	11487	15317	47096	1979	14709	1.0%	1546364
9	1413900	26743	88447	10604	14139	44704	1884	13340	0.9%	1427240
10	1298128	26138	84452	9736	12981	42251	1788	12018	0.9%	1310146
11	1184773	25303	80224	8886	11848	39710	1690	10749	0.9%	1195522
12	1074316	24163	75733	8057	10743	37060	1588	9537	0.9%	1083853
13	967270	22698	71034	7255	9673	34315	1482	8388	0.9%	975658
14	864156	20938	66138	6481	8642	31491	1373	7309	0.8%	871465
15	765540	18933	61030	5742	7655	28603	1260	6305	0.8%	771845
16	672021	16771	55742	5040	6720	25688	1144	5382	0.8%	677403
17	584173	14552	50350	4381	5842	22797	1028	4543	0.8%	588716
18	502452	12355	45026	3768	5025	19998	912	3790	0.8%	506241
19	427196	10259	39813	3204	4272	17324	800	3123	0.7%	430319
20	358692	8312	34756	2690	3587	14802	693	2539	0.7%	361231
21	297090	6551	29991	2228	2971	12478	592	2036	0.7%	299126
22	242394	4987	25564	1818	2424	10365	499	1608	0.7%	244001
23	194532	3660	21474	1459	1945	8472	415	1249	0.6%	195782
24	153409	2569	17691	1151	1534	6791	339	954	0.6%	154364
25	118878	1719	14210	892	1189	5320	272	716	0.6%	119595
26	90604	1100	11138	680	906	4079	213	528	0.6%	91132
27	67982	676	8545	510	680	3070	163	384	0.6%	68366
28	50248	398	6429	377	502	2272	123	274	0.5%	50522
29	36590	220	4761	274	366	1657	91	193	0.5%	36783
30	26272	115	3428	197	263	1181	66	134	0.5%	26406
31	18616	54	2441	140	186	833	47	91	0.5%	18707
32	13005	22	1700	98	130	577	33	61	0.5%	13066
33	8960	7	1154	67	90	391	23	40	0.4%	9000
34	6087	1	764	46	61	260	16	26	0.4%	6113
35	4064	0	499	30	41	170	10	16	0.4%	4080
36	2640	0	324	20	26	111	7	10	0.4%	2650
37	1643	0	206	12	16	70	4	6	0.4%	1649
38	961	0	126	7	10	42	3	3	0.3%	964
39	517	0	72	4	5	24	2	2	0.3%	519
40	249	0	37	2	2	12	1	1	0.3%	250
41	104	0	16	1	1	5	0	0	0.3%	104
42	36	0	6	0	0	2	0	0	0.2%	36
43	10	0	1	0	0	0	0	0	0.2%	10
44	2	0	0	0	0	0	0	0	0.0%	2

Table B.4 Risk margin based on 75% quantile single premium annuity

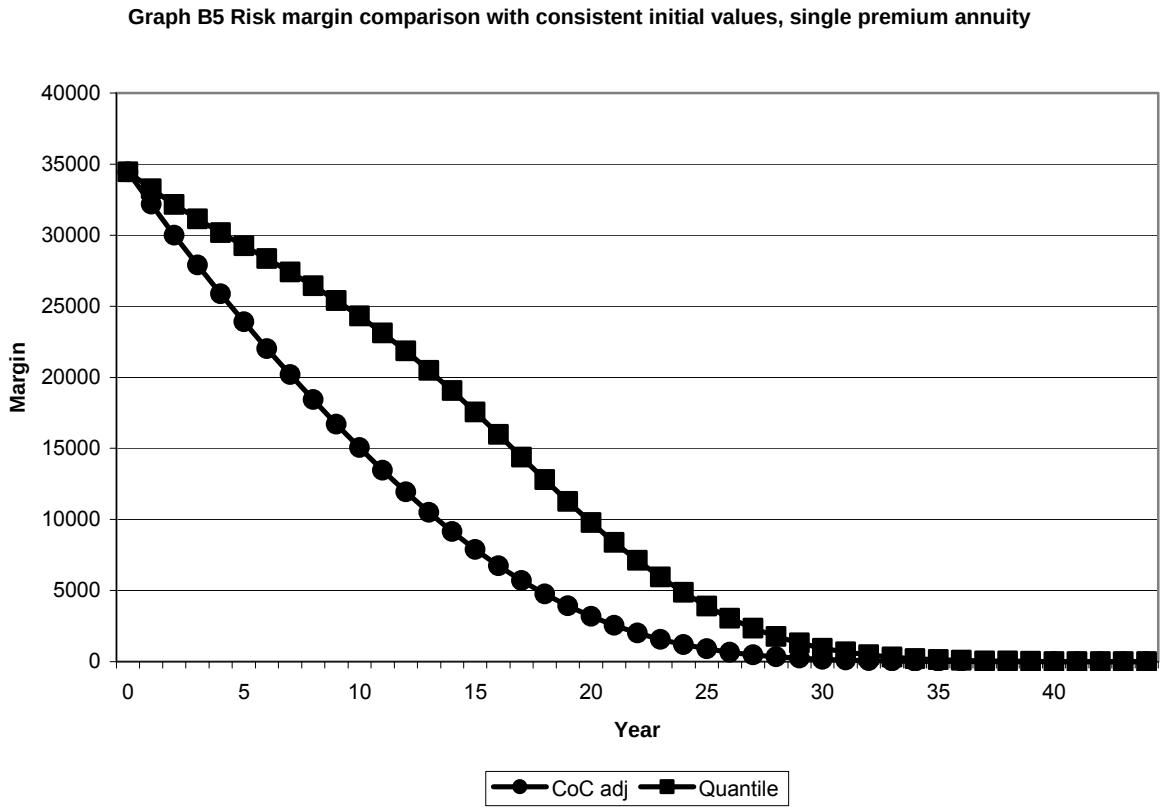
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
								=(7)+(2)	=(7)/(2)
				Square root of sum of squares					
Year	Liability Current estimate	Stand Alone Trend	Stand Alone Level	Stand Alone Expense	Stand Alone Operational	Total Risk margin	Release Risk Margin	MVL	=% (2)
0	2500000	15489	30471	3844	1825	34445	0	2534445	1.4%
1	2379318	13641	30060	3658	1737	33258	2393	2412576	1.4%
2	2258006	12035	29569	3472	1648	32155	2267	2290161	1.4%
3	2136303	10704	29008	3285	1560	31133	2147	2167436	1.5%
4	2014454	9673	28378	3097	1471	30177	2046	2044631	1.5%
5	1892734	8935	27674	2910	1382	29259	1975	1921993	1.5%
6	1771461	8450	26884	2724	1293	28342	1940	1799803	1.6%
7	1650977	8150	26023	2538	1205	27414	1920	1678391	1.7%
8	1531655	7961	25077	2355	1118	26439	1934	1558094	1.7%
9	1413900	7809	24058	2174	1032	25408	1957	1439308	1.8%
10	1298128	7632	22971	1996	948	24306	1991	1322434	1.9%
11	1184773	7389	21821	1822	865	23126	2031	1207898	2.0%
12	1074316	7056	20599	1652	784	21851	2084	1096167	2.0%
13	967270	6628	19321	1487	706	20493	2123	987763	2.1%
14	864156	6114	17990	1329	631	19057	2153	883213	2.2%
15	765540	5528	16600	1177	559	17545	2179	783085	2.3%
16	672021	4897	15162	1033	491	15974	2185	687995	2.4%
17	584173	4249	13695	898	426	14374	2159	598547	2.5%
18	502452	3608	12247	773	367	12796	2081	515248	2.5%
19	427196	2996	10829	657	312	11259	1985	438455	2.6%
20	358692	2427	9454	551	262	9779	1874	368471	2.7%
21	297090	1913	8158	457	217	8394	1727	305484	2.8%
22	242394	1456	6953	373	177	7116	1572	249510	2.9%
23	194532	1069	5841	299	142	5947	1418	200480	3.1%
24	153409	750	4812	236	112	4877	1278	158286	3.2%
25	118878	502	3865	183	87	3903	1145	122781	3.3%
26	90604	321	3030	139	66	3050	989	93654	3.4%
27	67982	198	2324	105	50	2336	822	70318	3.4%
28	50248	116	1749	77	37	1755	663	52003	3.5%
29	36590	64	1295	56	27	1298	518	37888	3.5%
30	26272	33	932	40	19	934	409	27206	3.6%
31	18616	16	664	29	14	665	302	19281	3.6%
32	13005	6	462	20	9	463	225	13468	3.6%
33	8960	2	314	14	7	314	165	9274	3.5%
34	6087	0	208	9	4	208	117	6295	3.4%
35	4064	0	136	6	3	136	80	4200	3.3%
36	2640	0	88	4	2	88	52	2728	3.3%
37	1643	0	56	3	1	56	35	1699	3.4%
38	961	0	34	1	1	34	24	995	3.6%
39	517	0	19	1	0	19	16	537	3.8%
40	249	0	10	0	0	10	10	259	4.0%
41	104	0	4	0	0	4	6	108	4.2%
42	36	0	2	0	0	2	3	37	4.2%
43	10	0	0	0	0	0	1	10	3.4%
44	2	0	0	0	0	0	0	2	0.2%

A true comparison between the two approaches can not be made. Even in the situation in which both approaches produce the same result, a small change in one parameter, for example, duration, may result in different margins.

The following is another example developed by setting the cost of capital percentage at 5.01% instead of 4% to equate the initial margin. Because of a different pattern of release of the capital the margins will differ over time. For ease

of comparison, see Graph B.5 for a comparison of the trend in risk margins over time with these equal initial margins.

Graph B.5 Risk margin comparisons with consistent initial values single premium annuity



Note that the use of 5.01% results in a risk margin equal to that produced using a 75% quantile is unique to this particular example, so that this equivalence should not be assumed to occur in other situations.

B2 Example – Risk margins for a term life insurance contract

The following term life insurance example is based on the same assumptions and models as is used in the immediate annuity example used in B1. Because the liabilities for term insurance are less stable than for a payout annuity, the economic capital expenses are expressed as a percentage of the premium. The calamity risk for term insurance is not relevant to the measurement of economic capital for annuities. In determining this capital, we evaluated the possible impact of a pandemic. An extreme scenario can be represented by a rerun of the Spanish Flu from 1918, which was by far the most extreme pandemic over the last 400 years. The impact of this pandemic was age independent and would lead to extra

mortality (absolute) of 0.15% to 0.25%, independent of age and gender. In this example, 0.15% is used. Other confidence levels are based on the Pareto distribution. The estimated effects of diversification relating to the components of mortality and mortality related risk are given in Table B.6.

Table B.6 Diversification effect

Risk	*Diversification factor*
Trend uncertainty	0.25
Level uncertainty	0.25
Calamity risk	0.50
Expense risk	0.50

For the quantile method, it is assumed that the underlying risks are independent. The results of the two methods in this example are given in Tables B.7 and B.8.

Table B.7 Cost of capital method based on a AA rated entity term life insurance

Year	Premium	Liability	Capital Trend	Capital Level	Capital Calamity	Capital Expense	total cap. before div.	div. effect	After div Total	CoC	CoC/Liab
0	3634	3,634	8,017	5,601	1,495	363	15,475	11,142	4,333	920	25.33%
1	3625	4,727	6,892	5,331	1,489	362	14,074	10,093	3,981	784	16.58%
2	3615	5,634	5,777	5,014	1,484	362	12,636	9,016	3,620	656	11.65%
3	3605	6,312	4,694	4,640	1,479	360	11,173	7,920	3,253	537	8.52%
4	3594	6,709	3,664	4,201	1,473	359	9,698	6,815	2,883	429	6.39%
5	3582	6,861	2,709	3,686	1,468	358	8,221	5,709	2,512	331	4.82%
6	3568	6,779	1,852	3,101	1,463	357	6,773	4,625	2,148	243	3.59%
7	3554	6,442	1,136	2,447	1,458	355	5,396	3,594	1,802	167	2.60%
8	3540	5,794	609	1,719	1,453	354	4,134	2,649	1,485	102	1.76%
9	3524	4,829	337	904	1,447	352	3,041	1,830	1,210	47	0.96%
10	0	-	-	-	-	-			0		

Table B.8 Quantile method based on 75% quantile term life insurance

Year	Premium	Liability	Trend	Level	Calamity	Expense	Margin before div.	Div. effect	Margin after div.	Margin % liab	release
0	3634	3,634	1283	1176	75	84	2617	873	1,744	47.99%	-
1	3625	4,727	1103	1119	74	83	2380	805	1,575	33.32%	238
2	3615	5,634	924	1053	74	83	2135	729	1,405	24.95%	233
3	3605	6,312	751	974	74	83	1882	647	1,235	19.57%	226
4	3594	6,709	586	882	74	83	1625	560	1,065	15.87%	220
5	3582	6,861	433	774	73	82	1363	469	894	13.03%	214
6	3568	6,779	296	651	73	82	1103	379	724	10.68%	206
7	3554	6,442	182	514	73	82	850	294	556	8.63%	197
8	3540	5,794	97	361	73	81	612	223	389	6.72%	189
9	3524	4,829	54	190	72	81	397	172	225	4.66%	180
10	0	-	0	0	0	0			-		234

As above, the quantile and the cost of capital methods are not completely comparable. To equate the starting level of the cost of capital method to that of the 75% quantile, we had to increase the cost of capital from 4% to 8%. Again, this is only the case in this example. Other age/duration combinations would lead to other percentages. In Graphs B.9 and B.10, the development over time of the “adjusted”

cost of capital and the 75% quantile method is shown. It is clear that the release of the risk margin over time based on these two methods is not the same.

Graph B.9 Risk margin comparison with consistent initial values term life insurance

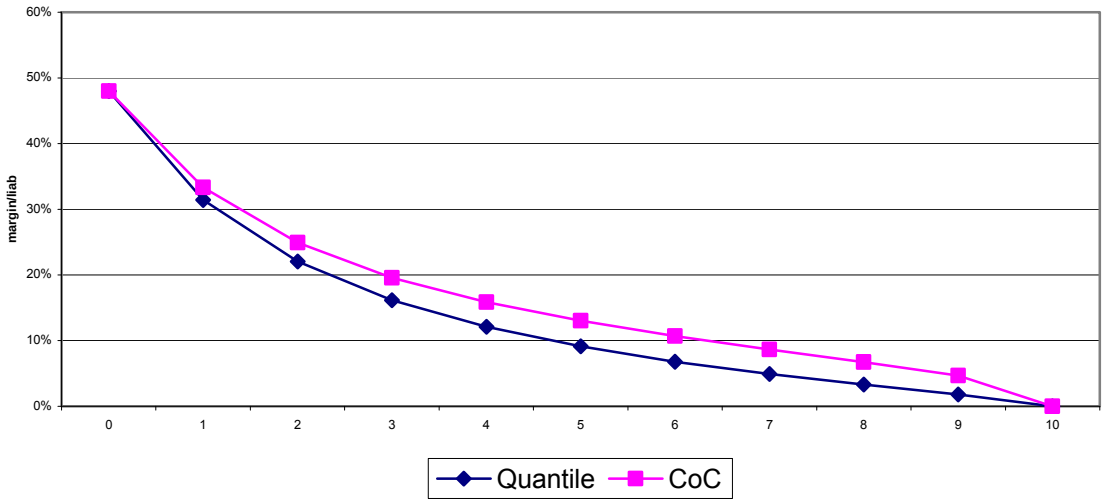
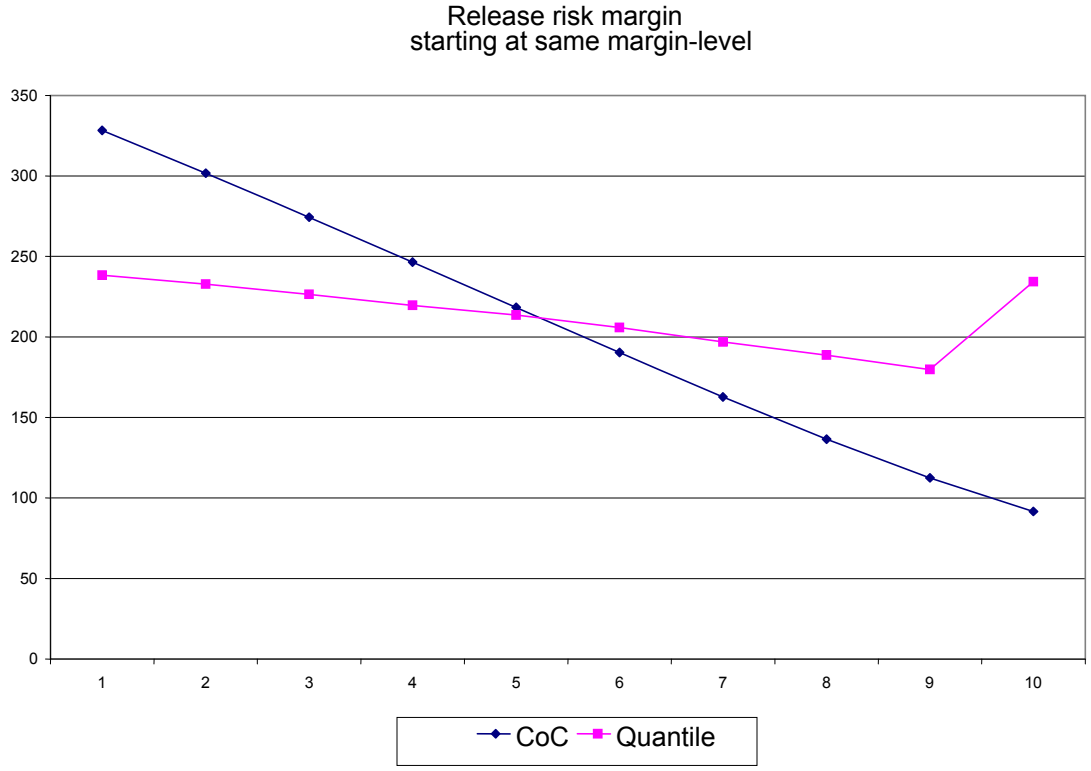


Table B.10 Risk margin release over time with consistent initial values term life insurance



The release of the risk margins as calculated by the cost of capital method generates higher profits in the early contract years. The "jump" in the last year in the quantile method is because of the release of the total remaining risk margin. In the cost of capital method this would not constitute profit.

B3 Models used

B3.1 Mortality assumption

The mortality assumption for the current estimate is based on a projection of Dutch population mortality, adjusted for use as insured mortality by using a factor of 0.80 (times q_x).

The average age of the portfolio of contracts is assumed to be12 years and yearly mortality data from 1950 though 1998 is available. In developing the current estimate mortality rates, the current estimate trend is based on the average trend experienced between 1988 and 1995 (In 1988 there was a significant change in trend observed). Within the 48 years of observations 9 separate trends are observed: so there is an average trend between 1950 and 1960 (i=1), 1955 and 1965 (i=2), etc.

Using the same formula used to calculate the current estimate mortality assumption, nine sets of factors are determined: $f_i(x)$ (i=1 to 9). With each set, $f_i(x)$, a generation mortality table applying calendar year trends is calculated using the following formula:

$$q_i(x;t+a) = f_i(x)^a \times q_{be}(x;t)$$

(In case of positive risk, for example in life insurance, it is advisable to limit a in the exponent, say, to 10 years)

Based on each generation table, i, a corresponding liability can be calculated. This results in 9 different liabilities: $liab_i$. For these 9 liabilities, a standard deviation can be calculated:

$$s_{trend} = \sqrt{\tfrac{9}{8}\{(\tfrac{1}{9}\sum_i liab_i^2) - (\tfrac{1}{9}\sum_i liab_i)^2\}}$$

The trend uncertainty calculated in this way is a student (t) distribution with 8 degrees of freedom (dof). In the student (t) distribution with dof=8, the 98% confidence interval is based on 2.5 standard deviations. This gives:

$$EC_{trend} = 2.5 \times s_{trend}(dof = 8).$$

Table B.11 gives the factors necessary to calculate the economic capital with the student distribution.

B3.2 Calculating economic capital using a student distribution

In Table B.11, the factors that can be used to estimate economic capital are shown that depend on the degrees of freedom reflecting the number of trends available.

The factors then are multiplied by the observed standard deviation. The economic capital factor (EC) is based on a 99.95% (1 year time horizon) or 98% (12 year time horizon for a AA rated entity) or 94% (12 year time horizon, equivalent to the yearly 99.5%), and for the quantile method at 90% and 75% confidence intervals.

Table B.11 Number of standard deviations needed in a student distribution

Degrees of freedom	EC 99.95%	EC 98%	Solvency II 94%	Quantile 90%	Quantile 75%
5	6.9	2.8	1.9	1.5	0.7
6	6.0	2.6	1.8	1.4	0.7
7	5.4	2.5	1.8	1.4	0.7
8	5.1	2.5	1.7	1.4	0.7
9	4.8	2.4	1.7	1.4	0.7
10	4.6	2.4	1.7	1.4	0.7

B3.3 When insufficient volume of data is available

Sometimes insufficient data will be available to determine certain historic trends for a given population. For example, when new mortality tables are developed only once every 10 years, an insufficient period of experience may be available to determine a trend.

In the case where there is a lack of trend experience, a standard set of trend factors may be able to be applied. This standard set might be based on an adequate set of historical mortality observations of groups of lives for whom data are available. The reason that this is possible is that we are trying to measure the possible changes of an historical trend over a given period. In general, these changes would not differ very much between different categories of lives. Nevertheless, these standard sets might differ by region, continent or stage of development that may be particular to the observed category or the category to which they will be applied.

B3.4 Mortality level uncertainty

The following describes an approach that could be used to determine the portion of economic capital attributable to the uncertainty determined with respect to the level of mortality.

A similar analytical approach to estimating the portion of economic capital that can be used to reflect volatility can be applied. This can be done because the level uncertainty is nothing more than the effect of a possible mistake in estimation. The reason for this possible "mistake" is the volatility in historical observations.

The method is based on the normal power (3) approximation (NP(3)). In this approach, the compound Poisson distribution is expressed in terms of a normal distribution using its first 3 moments. An issue in using this method for the level uncertainty is that the risk capital can sometimes be determined only in the last year of the period. Assuming that the portfolio is relatively stable over time in terms of average age, gender distribution and spread of the sum assured, a reasonable approximation of the NP(3) approach can be made. For relatively new portfolios care is needed.

The method used is as follows:

Define the ratio between the expected mortality rate for insured persons and the whole population by dividing the observed deaths over a certain period by the expected deaths over the same period, based on the population mortality or an industry (reference) table:

$$f_{be} = \frac{\mu_{obs}}{\mu_{ref}}$$

In the level uncertainty we reproduce the uncertainty in the observations μ_{obs} by means of an adjustment factor: $f_{ec} = \frac{\mu_{obs} + (-)unc_{ci}}{\mu_{ref}}$

with:

$unc_{ci} = \sigma(s_{ci} + t_{ci}\gamma)$

The factors s and t depend on the time horizon and confidence level, as indicated in Table B.12:

Table B.12 s and t values

Time horizon	Confidence level	s	t
1 years	99.95%	3.3	1.6
12 years	98	2.1	0.5
12 years	94	1.6	0.2
Quantile	90	1.3	0.1
Quantile	75	0.7	0.0

The standard deviation is:

$$\sigma = \sqrt{\sum_p q_p(x) X_{p_i}^2}$$

and the skewness:

$$\gamma = \frac{1}{\sigma^3} \sum_p q_i(x) X_{p_i}^3$$

This calculation would be performed over the same observations used in calculating f_{be}, preferably over the same period. A problem that can be encountered is that this type of dataset may not be available during the entire period. In that case, only the most recent dataset will be usable. With a weighting factor h, a correction needs to be made:

$$h = \frac{\sum_j N_j}{N}$$

where

N = numbers of policies in the available dataset
$\sum_j N_j$ = total number of policies used over the entire observation period.

In this case, the formulas for the standard deviation and skewness are:

$$\sigma = \sqrt{h \sum_p q_p(x) X_{p_i}^2}$$

$$\gamma = \frac{h}{\sigma^3}\sum_p q_i(x) X_{p_i}^3$$

The economic capital is estimated by first calculating the liabilities ($liab_{ec}$) based on the mortality rates:

$$q_{ec}(x;t) = fec \times q_{pop}(x;t)$$

Then the economic capital can be expressed as:

$$EC = liab_{EC} - liab_{BE}$$

In the examples, this risk is set at a 10% decrease of q_x's. The reason for using this assumption is that we don't have actual observations to determine the current estimate mortality for this portfolio. The 10% shock is based on experience obtained by the application of the models described in this Appendix.

B4 Other items

Among other risks not explicitly dealt with in the examples in Section 6.5 include the following:

1. An estimate of the effect of statistical **volatility risk** is not included because it will have no or hardly any impact on the economic capital associated with an annuity

2. **Calamity risk** is also set at zero, as this risk of mortality far in excess of expected mortality affects only risks for which increased mortality is an unfavorable factor.

3. **Expense risk** is estimated at 0.75% of the liabilities. This is a crude estimate and needs to be investigated further.

4. The same is true for **operational risk**, which has been set at 1% of liabilities, but will depend on country and entity and possibly product related factors. Further investigation is also needed for this factor.

5. **Diversification risk** (see Section 7.5 and Appendix C for a discussion of this risk)

The economic capital components resulting from the use of the models described in this appendix are stand-alone levels of capital at a portfolio ("sub-risk") level. Adding a portfolio to a well diversified AA rated entity results in a smaller increase in the total economic capital of that entity than

just adding together the components of capital otherwise determined. Each portfolio will have its own impact, depending on how well it diversifies into a large portfolio.

In this example, there is a portfolio of payout annuities. Such a portfolio will diversify more effectively in an entity with, on average, a positively correlated risk with the portfolio being assessed (for example, through term insurance or endowments) and less effectively in an entity that has already a majority of negatively correlated mortality risks like annuities. The assumption made is that a "positive risk" entity takes over the portfolio.

The diversification factors are based on the experience of a AA rated entity with, on average, a positive risk profile. Diversification effects at a group level are allocated on a marginal basis. The results for the risks are given in Table B.6.

For the quantile method, it is assumed that the underlying risks are independent (i.e., no tail correlation adjustment is needed at the 75% level).

For the cost of capital method, the cost of capital is set at a constant 4%. This level may be reasonable, but investigation needs to be conducted to confirm this. If the SCR (Solvency II capital, based on a rating of BBB, or 99.5% based on a one year time horizon) is used instead of the higher economic capital for a AA rated entity, this percentage will be higher (for example, 6%).

APPENDIX C – Diversification

The objective of this appendix is to provide additional insight on the topic of diversification. First, some general theory is provided. Then various technical approaches are discussed. It ends with a discussion of the concept of marginal diversification.

C1 Some general theory and thoughts

Diversification is critical to risk management. Diversification forms the foundation of insurance and is the key-stone on which important risk management processes rest. Note that in the context of this appendix, pooling of risks is included as a special type of diversification. Diversification exists because of:

- Law of large numbers
- Offsetting (sometimes referred to as opposite) risks
- Independent (sometimes referred to as unconnected) risks
- Risks that are less than 100% interdependent.

The combination of risks that are not totally independent results in the diversification effect: the total capital related to the combination of (sub-) risks is equal or lower than the sum of the capital determined for each sub-risk.

Part of these diversification effects, such as the law of large numbers, will already be included in the models used to calculate the capital, for example, the volatility over the modeled group of business. The effect of negatively correlated risks that exists within the modeled group of business this effect will also be reflected in the capital model. This latter is also called the netting effect. The diversification between the risk types and because of combining modeled blocks of business is reflected in the diversification model.

The diversification effect can be calculated at several levels:

a. Between sub-risks within a risk type
b. Between risk-types within a modeled block of business, for example a line of business line or business unit.
c. Between lines of business and/or business units.

C2 Technical approaches

In the *Blue Book*, the IAA proposes the use of copulas as the theoretically correct method to calculate diversification effects. Indeed in general we can say that the use of a “standard” correlation matrix is wrong. Copula functions have the advantage that they can be used to accurately combine

other distributions than from the "normal family". They also recognize dependencies that change in the tail of the distributions.

Severe incidents can impact risks that are normally independent. An example: normally market risk and mortality risk will be independent. But in case of a severe pandemic like the Spanish flu would happen with millions of deaths worldwide this will certainly have economic consequences and will also impact market risk, for example equity risk. In practice, combining several distributions implies that the dependency in the tail is greater than average risks. In applying copula functions this can be handled, while in a standard correlation matrix this is not possible.

However, copula functions are rather complex to use, particularly in case a large number of distributions have to be combined. A practical solution can be to adjust the correlation matrix in such a way that the confidence level we are interested in, the combined distribution results are reasonably correct. The adjusted correlation factors are also called "tail-correlations". More background of this simplified approach can be found in Group Consultatif (2005).

C3 Marginal diversification

In the method described above the diversification effect can be estimated for a given portfolio. In the quantile approach, the diversification effect is calculated over the portfolio we want to know the 75% quantile around the liabilities.

If an exit value is being estimated using the cost of capital approach, we need to know the marginal impact of the portfolio on the (economic) capital of the entity that takes over the obligations. Because of diversification effects within the transferred portfolio and between the transferred portfolio and the already existing portfolio, the increase of the capital will be less than the sum of the risks of the transferred portfolio and also less than the diversified capital of the transferred portfolio.

A simple example is included here to illustrate how this might work:

Suppose there is a portfolio with a capital of 1000. We want to add another portfolio with a separately calculated capital of 100. Suppose this added portfolio is independent from the original one, so that the risks in the two portfolios are independent. This means that the total capital will be:

$\sqrt{1000^2 + 100^2} = 1005$.

Adding the new portfolio only increases the capital by 5 (or 5% of the original 100). In case the two portfolios are not independent, but there is a correlation factor of 0.25 between them, the total capital would have been:

$$\sqrt{1000^2 + 100^2 + 2 \times 0.25 \times 1000 \times 100} = 1030,$$

an increase of 30 (or 30% of the original 100).

These estimated impacts for each of the risk types shown in Table 6.10. The question is whether these factors should be combined according to a more proportional rule. A complication is that some risk types diversify better than others. Therefore a compromise approach is chosen: the use of risk “Buckets." We categorize the risk types into groups, based in each of their levels of diversification.

Risk types with marginal diversification effects between 1% and 25% are allocated to the 25% bucket, between 25% and 50% to bucket 50%, etc. This process includes rounding in which some additional margin is created. In case the transferred portfolio creates more diversification for a certain entity, the Bucket system leads to some conservatism in the margins, and the other way around.

The reason for using the Bucket system is that it is difficult to define a unique, well diversified insurer. In the Bucket system, the diversification effects of most insurers will satisfied. In the Bucket system it is less important to define the reference entity.

Table C.1 Diversification credits

Level of diversification	Capital after diversification
Full	0%
High	25%
Medium	50%
Low	75%
None	100%

Transfers will not change the reference entity, because that will be based on the “market” and the market itself will not change because of the transfer. However, they will change the risk profile of the real company that actually takes over the portfolio.

Based on experience and testing, the types of risks shown in Table 6.10 can be ordered according to the buckets shown in Table C.2 (note that this table includes life, health and property & casualty risks).

Table C.2 Ordering of risk types

	Buckets	
Risk type	**Life**	**P&C**
Mortality level uncertainty	25%	--
trend uncertainty	25%	--
volatility	0%	--
calamity	50%	--
catastrophe credit risk reinsurance	50%	--
P&C current non-catastrophe uncertainty	--	25%
current non-catastrophe volatility	--	0%
current catastrophe risk	--	75%
catastrophe credit risk reinsurance	--	75%
claims development risk - volatility & uncertainty	--	25%
Morbidity uncertainty	25%	25%
volatility	0%	0%
claims development risk	0%	0%
calamity	50%	50%
Expense	50%	50%
Persistency volatility & calamity	0%	0%
uncertainty	50%	50%
Premium re-rating risk	25%	25%
Credit risk	75%	75%
Transfer risk	25%	25%
Operational risk capital	--	--
Interest rate risk	--	--
Currency risk	--	--
Real estate risk	--	--
Equity risk	--	--

The percentages listed below are not recommendations from the IAA but are included for illustrative purposes.

In the above table all volatility risks are set at 0 (full diversification). Alternatively they could also be assigned a relatively small, e.g., 25% value.

APPENDIX D – Current Estimate Assumptions

This appendix contains a discussion of selected specific assumptions (measurement inputs) to the calculation of current estimates of insurance liabilities (and reinsurance assets). In general they represent current practice, rather than an indication of what might be used in a particular financial reporting system. They generally apply in deriving an estimate of an insurance liability, rather than the determination of the reasonableness of an estimate, which may take the form of a derivation of a range of probable values.

D1 Mortality rates

In this section, the setting of the mortality assumptions for use in the current estimate of death benefits is described. Expected mortality rates can be separately discussed in terms of: (1) its *level* that describes expected mortality during the last observation period and (2) its *trend* that describes the expected changes in mortality over the period of coverage, beginning with the period from which mortality was last observed, to develop current estimates of expected future mortality benefits. Most of this discussion also applies to survival rates.

D1.1 The level

D1.1.1 Insured mortality of the portfolio is not the same as population mortality. In general, the mortality of the insured population for life insurance is lower than that of the general population because of the effect of underwriting (selection) at issue. The difference depends on the period since underwriting, through so-called *select mortality*. The period of the select mortality depends on the extent of underwriting and age at time of underwriting. Experience has shown that it can last from 5 to 25 years, with a shorter period if no selection was performed or if voluntary termination rates are high. This period would be validated with mortality studies of the particular portfolio or similar insurance portfolios subject to the same underwriting standards, where relevant experience data is available. Mortality after this select period is referred to as *ultimate mortality*. If a portfolio of contracts experiences considerable voluntary terminations at or near a particular time (e.g., after a significant premium increase) or if no underwriting is conducted initially, anti-selection effects (unhealthy lives are less likely to terminate, giving rise to mortality higher than the ultimate level) may be experienced over time. Even if limited voluntary terminations occur or if not underwriting is conducted, mortality may differ depending on the insurer's target market.

D1.1.2 The mortality rates for most payout annuities will be lower than population mortality because healthier (than the general population) individuals usually choose to purchase payout annuities.

D1.1.3 In some countries, mortality tables for certain products, types of underwriting, markets, individuals or types of insurer have been developed for the insured population based on statistics from portfolio, entity, industry insured or general populations. Differences in the market in which an entity operates, the intensity of underwriting and risk classification systems between portfolios and insurers can significantly affect expected mortality. In other cases where relevant insured experience is not available or is not of sufficient size, population tables have been used with adjustments developed from other sources to reflect expected or partially observed differences arising from the underwriting of the entity's target population. As an approximation, these adjustments have been expressed as an adjustment to age (e.g., insured mortality age y = population mortality x-5) or by an adjustment to the mortality rates themselves (q_x) by a multiplicative factor applied to the mortality rate of an individual age or an age group basis, often reducing by contract year. These adjustments may also vary by gender or other risk classification factor.

D1.1.4 Where relevant experience data is available, the estimation of the current mortality level applicable to the demographic and risk characteristics of a portfolio of insureds would be subject to statistical analysis, including:

- The mortality experience analyzed would ideally be based on the reporting entity's own portfolio of insureds with similar risk characteristics that were subject to similar underwriting approaches.
- The expected difference between the mortality of an insured population and the population from which the benchmark mortality experience was developed would be reflected, depending on such factors as age, gender, health, and smoking status, as applicable.
- The product type, type of sale and market involved: for example mortgage or pensions, term insurance, whole life or annuity.
- The issue year (select period).
- Underwriting procedures; for example, guaranteed issue, medical exam, or blood tested.
- Differences between the risk classification system in effect during the experience period and the business for which current estimates are being developed.
- Measurement based on sums (net amount) at risk rather than numbers of policies.
- Anti-selection effects caused by available termination options.

D1.1.5 Differentials in the mortality assumption (e.g., by risk class or product type) in the measurement of liabilities may not be necessary if not considered in

underwriting or pricing, as long as the business is not subject to adverse selection as compared to the entity's competitors. That is, if premiums do not differentiate between a given risk characteristic of the insureds, the resulting experience of a given subcategory may not be the same as if they were individually selected. An example where it might not be reasonable to differentiate among population segments is if no insurer could legally differentiate their premiums between genders. In this case, it may be reasonable not to use gender-specific mortality tables for financial reporting purposes either. However, if applicable experience relativities are available from the portfolio or other portfolios that use similar pricing differentials, the experience relativities would normally be used if they reflect the experience of the actual mix of insureds in the applicable portfolio.

D1.1.6 Reflection of the expected mortality experience of an individual insured is usually not practical or useful, as measurement (unit of account) is usually portfolio-specific. It is common to use the expected mortality experience of the contract with respect to the risk classification category it has been allocated to in the underwriting process.

D1.1.7 Experience of similar groups of insureds is often the most relevant experience available that can be gathered. This may not be available in sufficient size to provide a fully reliable measurement base. To the extent that this experience is credible (that is, of a sufficient size and homogeneity), it would be used.

D1.1.8 In certain cases, statistical relationships between the experience of different insured groups cannot be precisely measured or can only be partly measured. If that is the case, less refined assumptions or sets of relativities may be justifiable, although if possible the reasonableness of such groupings or relativities would be validated in some manner, possibly through credibility techniques measured in terms of number of expected claims or volume of business. Important factors that can be considered include the mortality of the specific portfolio and the insured exposure (e.g., sum assured, face amount or net amount of risk), rather than number of policies or lives.

D1.1.9 If an estimation of mortality rates using age-dependent factors cannot be determined because the amount of experience in the estimation cells are too small (e.g., for a niche market), it may be possible for most ages to use age independent factors or theoretical mortality models (e.g., Gompertz or Makeham). In case of observed groups that are too small, products might be broadly grouped into positive risk (e.g., term insurance, universal life insurance, unit-linked life insurance, and whole life) and negative risk (e.g., pure endowment and payout annuities). In case no observations are available, (margin free) industry tables might be used with a constant percentage adjustment applied to all the mortality rates (for example +/-

20%, depending on an assessment of the relative effectiveness of the underwriting screening performed and the market penetrated). Although such an adjustment may be constant for several years, and some adjustment may be appropriate in the ultimate, as a percentage it would normally be expected to decline as the portfolio ages. The less accurate the data is, the higher the uncertainty, resulting in a higher risk margin assumption.

D1.2 The trend

D1.2.1 Because expected mortality rates change over time and can significantly affect current estimates, it is important to account for this expected change in setting assumptions for current estimates. For a long time, especially during the last century, life expectancies have increased (mortality rates have decreased). For most insured populations, life expectancies are expected to continue to increase in the future. An important issue is thus how fast the mortality rates will decrease and for how long.

D1.2.2 The historical decrease in mortality rates has been a result of positive and negative forces affecting the health and mortality of humans. The historical changes in mortality have been mainly caused by a combination of factors, sometimes positive (+) and sometimes negative (-), including:

- Medical and disease developments (+)
- Environmental effects (+ or -)
- Behavioral effects (+ or -)
- New diseases (-)
- For insured populations, changes in underwriting methodologies (+ or -).

D1.2.3 The effect of these trends can differ by population categories. For example, the net effect by age or gender may differ due to the relative effect of these factors, e.g., a new disease may significantly affect the very young but not affect at all those in their middle ages and changes in smoking habits can affect a cohort of insureds over a long period of time.

D1.2.4 Mortality rates for insured lives may also affected by improvement in underwriting methodologies (e.g., blood testing) or deterioration as a result of reduced underwriting screens necessitated because of the cost of the screens compared with their expected value.

D1.2.5 The rate of change in mortality rates was and is not expected to be constant. Several changes in trends have occurred, even in periods of generally increasing mortality rates, such as experienced in some countries for males at some age groups (45-75) between 1955 and 1975. This “hump” was caused by three negative drivers of change: increased frequency of heart disease, lung cancer due to smoking, and traffic accidents.

D1.2.6 The effect of these three drivers of change in the U.S. has been offset since the mid-1970s by medical developments and behavioral changes (e.g., the effect of significantly reduced rates of smoking by males, with effect of the smaller decrease by females expected to emerge shortly and enhanced treatment of blood pressure problems,). Other examples of increased mortality have included the effect of the AIDS epidemic in certain countries for certain ages and genders in the late twentieth century and the increase in alcohol use by Russian men in the late twentieth century.

D1.2.7 These and other potential factors can make it difficult, if not impossible, to reliably predict future mortality over a long period of time. Several methods to predict mortality have been in use, most based on an analysis of historical data over various time periods (e.g., through the application of the Lee-Carter method), sometimes supplemented by expert medical opinions.

D1.2.8 Very detailed models that have been constructed to estimate future mortality trends can be classified in the following manner:

1. By cause of death. Problems with this approach include: the lack of knowledge of the effect of new causes of death or new treatments or medicines, a lack of sufficiently detailed and accurate historical data with possibly misleading historical trends, and the possible lack of correlation between historical and future patterns in these causes.

2. By structure. A mortality table can be partitioned into 3 or 4 age segments:
   - child mortality (decreasing by age);
   - aged portion (exponentially increasing);
   - large middle age segment with relatively constant accident causes (except for certain age groups such as young males); and
   - large middle age segment for sickness causes (gradually increasing by age).

   Effective implementation of this model requires a detailed experience data base. In addition, in some cases cohort groupings may be appropriate.

3. General model. For all causes of death combined, historical experience trends are extrapolated into the future. Future changes in trends can be ignored.

4. Expert opinion. Experts provide their opinions regarding the level and period of future trends in the aggregate or by certain demographic segments or causes. A problem usually encountered using this method is that rarely do two experts arrive with the same conclusions regarding expected trends.

In practice, combinations of these four models are often used. For example, a calculation might be based on a general model, but validated with expert opinions, possibly with differential trends by large age segments. If properly controlled, such differences can be used to enhance the projection process.

D1.2.9 Just as is the case with other assumptions, the validation of their reasonableness is important. Do the future levels and relativities in tables look reasonable? A simple application of a statistical formula may not provide reasonable results. The results would be compared with other published projections. If appropriate, it may be important to compare the results from nearby countries in a relatively homogeneous geographical region, as they may not be expected to be significantly different.

D1.2.10 The expected level and changes in policyholder behavior, particularly policyholder persistency, can affect the mortality of a portfolio. This behavior can vary by such factors as premium or bonus/dividend patterns by duration or age, particularly compared to current product design available in the market, or changes in health.

D1.2.11 If sufficient portfolio experience is available, it is usually preferable to evaluate its historical trends rather than those of the industry as a whole or those of the general population, as portfolio experience should be more relevant and more homogeneous over time. However, relevant portfolio experience is often not of sufficient size to permit this trend analysis. In addition, if changes in significant underwriting procedures or criteria have been applied over time, comparisons of general population may be more reliable. Observed and expected differences between these two types of experience sources can exist if portfolio-specific underwriting has selected out specific exposures (e.g., those with a history of cardiovascular disease) which are subject to different trends than other causes of death. In certain circumstances, such differentials can overwhelm or hide relevant underlying trends. Because the insured population may be subject to different influences than the aggregate population, caution is needed to use general trends without adjustment. It may be appropriate for both types of sources of information to be considered.

D1.2.12 The use of smooth tables based on Makeham or Gompertz models to estimate trends is usually not appropriate – these models spread special circumstances only applicable to a certain age group over a major segment or the entire table. Nevertheless, alternative approaches exist where the structure of the mortality table remains intact (see for example *NAAJ* vol. 6 no. 2).

D1.2.13 Depending on the volume of the experience base, it is often desirable to aggregate several years of experience to provide sufficiently credible experience. However, if too many years are used, there is a risk that the

experience may be too out-of-date for use without adjustment. If the experience is out-of-date considering the expected trend in mortality during the period between the average period of the experience and current conditions, but is still relevant to the portfolio of risks, a trend factor would be applied to bring the experience to the conditions expected in the applicable future period.

D1.2.14 The time period over which a trend factor is to be applied needs to be determined. Differences of opinion exist regarding their application over different periods, especially regarding whether an expected improvement trend should be decreased after a period of time, such as ten or twenty years. The results of an extrapolation of the same trend factor forever may result in an overstatement of the aggregate effect of the trend over the long term.

D1.2.15 Although most actuaries are used to estimating and applying some type of trend in mortality improvement in the case of annuities, in part to be conservative, some feel uncomfortable with applying such trends to life insurance contracts in which improvements in mortality represent the opposite result. Although this may affect the risk margin applied, there is no conceptual reason why the expected trend factors would be different for these two types of coverages. If there is, it might be a sign of the use of such trends for prudence purposes, which may not be appropriate in certain financial reporting systems.

D1.2.16 In some jurisdictions, there is an implicit assumption that premium rates will be reduced in response to improving mortality. An example is stepped premium products that provide policyholders an opportunity to cancel and re-enter at new business rates. It may be normal market practice in this case to reduce premiums from time to time to reflect improving mortality. The alternative would be to incorporate an offset to improving mortality from selective lapses if premium rates are not reduced.

D1.2.17 Mortality trend models can be based on various factors, such as attained age and year of birth (cohort). Historical cohort trends are not always evident in various cohorts, although age effects have been. In addition, sufficient observations for recent birth-years are rarely available from which to produce projections. However, in either case their future effect can be difficult to estimate. Mortality projection models currently in common use include:

(2) Lee-Carter, used in several countries, is based on an ARIMA model. A problem is the fact that the dependency of the development between ages may not be properly modeled. In addition, the selection of the base historical period may be somewhat arbitrary.

(3) P-Spline. This method has been used in the U.K.

(4) Extrapolation through the mortality rates by age and gender based on recent observations. In many countries, this approach is the most commonly used. Some such models reflect trends or projections of mortality by cause of death, either as a general consideration or as an integral part of the calculations performed.

D1.3 An example of determination of the current estimate for mortality incorporating information about level and trend

One of the co-chairpersons of the RMWG, Henk van Broekhoven, has published a paper (van Broekhoven (2002)) concerning how to use current and past observations about mortality to construct current estimates for levels and trends of mortality. While the mortality risk is just one of the many risks assumed by certain insurers, the thought process developed in the paper can be applied to many other important insurance risks as well.

The method described in the paper is meant to be a practical one. Although more sophisticated models exist, for practical reasons Henk chose a model that was both easy to use and explain. The future trend he used was based on population mortality development observed during a recent period, although in practice expectations of trends would be considered at regular intervals. Older historical experience also can provide context as to how the trend can change over time. These observed changes are used to measure the trend uncertainty. Entity or portfolio observations regarding trends will normally demonstrate relatively high volatility due to the fact that the number of observations is smaller than that of the overall general population and to the effect of changes made in underwriting criteria over time. These volatile observations give rise to expectations concerning the level of uncertainty. This uncertainty is derived using a statistical method by measuring this volatility.

In the paper, calamity (or "extreme event") risk is based on the only historical observation for which data is available – the Spanish Flu in 1918 - 1919. This pandemic caused a doubling of mortality for the younger ages over a one-year period after which mortality levels returned to trend. The calamity capital for mortality is based on this scenario.

D2 Property & casualty (general) insurance claim development

In this section, the estimation of future cash flows relating to property & casualty (general) insurance claims (and related expenses) for claims that have already been incurred is discussed. This liability includes estimates for reported and unreported claims. In general, these are assessed here in the context of a gross of ceded reinsurance basis of measurement, i.e., it does not reflect the effect of the specific measurement of or credit risk associated with ceded reinsurance assets. This section does not describe all of the many methodologies that have been developed. Rather, it describes some of the major considerations and approaches to the estimation of these cash flows.

In addition, it is common to use multiple methodologies in the process of developing estimates for these cash flows, sometime using estimates based on a blend of the methodologies.

D4 discusses estimates for unexpired risk liabilities for a stand-ready obligation, i.e., claims that have not occurred on contracts written or the estimation of potential reinsurance recoveries. Except for cases in which there exist evidence to the contrary, estimates of the stand-ready obligation use early experience (that is, relatively soon after claims are incurred) underlying the estimation of claim development.

Although the following primarily relates to the liability for property & casualty insurance claims, much of it also relates to claim liabilities for other insurance coverages, particularly for many forms of health insurance.

D2.1 Case liabilities, incurred but not reported (IBNR) liabilities, and incurred but not enough reported (IBNER) liabilities

In the analysis of claim liabilities, expected claims may be separately categorized and separately assessed in the following manner:

- Case liabilities are those liability values assigned to individual claims that have been reported and recorded with an individual estimate at the valuation date, often set by claim adjustors, although for certain coverages, such as disability income, they are set by factors that are a function of the major characteristics of the claimants or claims. In some cases, these are assigned on an average basis depending on the type of claim involved, although this is usually applied when they are expected to be small or prior to insufficient information regarding the claims being obtained, without sufficient information to assess it on an individual basis.

- Incurred but not reported (IBNR) liabilities are for those claims that have not been reported to the insurer at the valuation date. In certain cases this includes cash flows associated with claims that may have been reported to the insurer but have not yet been recorded in the insurer's data base. In neither case has a case liability been assigned (pure IBNR). In some cases the IBNR refers to the sum of (1) a liability for incurred but not enough reported (IBNER), which the difference between the total expected cash flows for a cohort of claims, less those cash flows that have already been paid, and less any current claim liabilities, and (2) the pure IBNR. This combined liability is also sometimes referred to as the bulk or actuarial liability, in that the amount is not attributable to specific claims.

The claim liability is measured for a specified cohort of claims, often grouped by type of claim and such periods as the year of accident, loss or notice (referred to as the accident or loss year, depending on the coverage and situation). The liability is either estimated on the basis of total losses expressed in terms of currency units or in terms of losses separately evaluated by their expected claim frequency and size, depending on the coverage and data available (these methods are more fully discussed in D3.5).

D2.2 Loss adjustment expense (LAE)

D2.2.1 Expenses associated with the claim liability are usually analyzed in the same manner as losses, although sometimes independent techniques are applied. Although in most cases they are analyzed separately, there are exceptions if LAE is small in relation with the losses, in which case they are estimated on a combined basis. In part, this is due to the options available in managing claims. In some cases, an entity can incur additional expenses to avoid making or to reduce the amount of claims payable; in contrast, if the entity decides to pay all of the claims submitted, there will be little claim expense, but a larger amount of losses – this indicates that losses and a certain amount of their related expenses may be negatively correlated.

D2.2.2 Differences in the definition of LAE categories can be important in any comparison and analysis of trends in these expenses, as they can differ by accounting policy or jurisdiction. Potentially important are expenses associated with coverage disputes (between the policyholder and insurer) that can sometimes be significant but may be accounted for differently between accounting systems and allocation of overhead.

D2.2.3 A common method is to separately analyze the expenses that can be associated with individual claims (allocated, sometimes referred to as allocated loss adjustment expenses) and those that cannot (unallocated, often consisting of claims and legal management and staff and their related

costs, sometimes referred to as unallocated loss adjustment expenses). Different methods are usually applied in the estimation of these two types of LAE. In addition to the type and mix of claims and the accuracy of expense allocations, the entity's claim management practice can also contribute to the relative amount of expected LAE in relation to losses, the relative amount of the two LAE or other types just referred to, as well as the speed of claim closing.

D2.2.4 Another aspect of the level of LAE may be due to relative efficiency of the entity's claim management process. Assuming that LAE is a non-market assumption, it would have to be measured on a portfolio-basis, reflecting the mix of claims and the business infrastructure used for managing the claim function, while if a market-based assumption, then some indication of what the market would charge for this function may be more relevant.

D2.2.5 Although in some areas, third party LAE fees charged might be observable (e.g., from third party administrators or outsourcers), recent historical LAE portfolio-specific development measured with respect to the portfolio or type of insurance coverage usually provides the most relevant and reliable experience from which to estimate future expenses. A review of third party claim administrator fees, although useful as a benchmark measure for this purpose, can provide misleading information, as they often vary widely by the specific claim portfolio's characteristics and volume of expected claims involved.

D2.2.6 Differences in the speed, claim management process and decision making can make a major difference in the overall claim and LAE costs. In addition, the interaction between claim management, LAE and claim severity is important in the analysis of claims, their losses and related LAE.

D2.2.7 Estimates of LAE consider historical and planned changes in the claim management function. The effect of such changes can sometimes be estimated on the basis of annual expense budgets, but in some cases may vary as a result of changes in mix and volume of claims.

D2.3 Exposure to risk, frequency and severity

D2.3.1 Where available, analysis of experience is performed by exposure to risk, often measured by the premium charged or per contract, with the unit used varying by coverage.

D2.3.2 The frequency of claims is analyzed for coverages with relatively homogeneous claim exposure and claim count definitions, particularly for personal lines (e.g., protection against auto or home property claims), reflecting the ratio of the number of claims divided by the exposure to risk (although premium is sometimes used instead). There are several possible

measures of number of claims that differ by coverage, e.g., the number of occurrences, the number of claimants, and the number of claims. This is not as often performed for other coverages, especially where contract exposures and claim counts are not homogeneous. A question could be raised as to whether a notification is or is not a claim, particularly under claims made and liability policies.

D2.3.3 Severity (average size of claims) is a metric that represents the size of the claims. The expected claim cost per exposure unit is equal to the product of the estimated claim frequency and the corresponding estimated average severity.

D2.3.4 The use of certain exposure metrics may be problematic. For example, the pricing exposure base for commercial automobile liability coverage sold to garages could be the amount of sales or the garage area in square meters/feet, while that for truckers could be the expected driving distance. In such cases, the resulting frequency and severity calculations for each component would not be easily combinable into a single meaningful frequency and severity measure for total commercial automobile liability.

D2.3.5 Loss and LAE payments. To discount expected claims, the expected loss and LAE payment patterns are needed. These are generally applied separately on a coverage-specific basis, reflecting the expected payment pattern measured from the end of the loss year. In many cases, historical payment patterns can be determined for this purpose. In long-tail coverages, this can be more difficult, particularly for claims involving possible mass torts or new or slowly emerging types of claims, e.g., claims due to asbestos or lead paint liability.

D2.4 Relevant experience data

D2.4.1 In most cases, the analysis of claim development is primarily based on portfolio-specific data. Portfolio-specific data, rather than industry data is generally considered more relevant because it is based on the risk characteristics, coverage mix, and types and location of customers covered, as well as other characteristics such as claims handling.

D2.4.2 The measurement of obligations is typically determined separately by coverage or groupings of similar coverages with similar development characteristics and might be further segmented by type of claim, customer, policy, or size of claim, or geographic regions. Grouping of experience data used for measurement of claim development often differs from groupings used for pricing purposes and reflects recent experience. Among other differences, pricing might reflect jurisdiction or rating territory within jurisdiction, as well as using portfolio-specific data for pricing limited ("basic") coverage, relying on broader groupings or even industry data to

estimate the additional cost for the broader set of coverages. In contrast, liability measurement will often be based on a wider grouping of coverage, customers, markets and jurisdictions. As another example, many entities price using "basic limits," while relying on industry advisory factors where available for the additional cost of higher limits, or utilize models to estimate the additional charge necessary for higher limits.

D2.4.3 Nevertheless, there are many situations in which portfolio-specific experience data does not provide a relevant or reliable indicator of the ultimate loss experience of a cohort of claims. In those cases insurance industry data may be the only credible alternative if, for example, the portfolio is new, small, in the process of undergoing significant management changes or in which claims are expected to be of a low-frequency, high-severity nature. Also, for certain long-tail lines of business, few entities have sufficient historical experience to make coverage or portfolio-specific information reliable or cover the full expected claim settlement period; in this case the entity would usually use industry experience to supplement its own experience data. In many cases, industry data is viewed as a last resort. Entities are more likely to extrapolate the portfolio specific experience, perhaps based partly on industry experience for estimating the tail, even though the tail is very dependent on the portfolio and the claim handling particulars of the portfolio. Also, industry data is generally only available at a high aggregate level that is broader than many categories used to measure claim liabilities by the medium to larger entities.

The selection of the proper balance of portfolio and industry data and the categories for analysis of claim liabilities often requires professional judgment reflecting the facts and circumstances involved.

D2.5 Methodologies

D2.5.1 Experience data would be adjusted for changes, if any, in conditions, including the law or regulations, claim processing procedures, underwriting selection, and claim coding, although in some cases these adjustments are made implicitly. In some cases claim experience is adjusted to a common level of historical rates of inflation, particularly if inflation has varied significantly during the experience period or is expected to be different in the future than in the past. If the benefits are directly affected by inflation, separate estimation of inflation is appropriate. Unusual data points or particularly severe individual claims can be excluded from the analysis and estimated separately. It is important to both avoid double-counting and forgetting about these unusual claims. These factors are usually appropriate if they can be validated by relevant historical experience, with uncertainties in these factors reflected in risk margins.

D2.5.2 For many products, estimated claim liabilities can be based on such methods as paid and incurred chain ladder (also referred to as link ratio,

triangulation, or development) methods, cost per claim closed, frequency-severity, Bornhuetter-Ferguson (where a prior expected claim levels based on a relevant exposure base is used for early period of the claim cohort), Cape Cod, Mack's method, and loss ratio-methods. Some of these only depend on historical claim development experience, while others also reflect estimated claims (using claim frequency and severity), policies, exposures, or premiums. Depending on the method, one or more variables may be used to estimate the expected claim development.

D2.5.3 Usually estimates of liabilities are based on more than one methodology – their results are assessed to determine which appear to produce more reliable and reasonable estimates. In some cases an average of two or more methodologies for the basis of the estimate, sometimes differing by claim cohort often separately by accident, report or underwriting year.

D2.5.4 Statistical modeling approaches can also be applied, albeit they are less common in many jurisdictions. Various refined methods, including those using stochastic simulation methods, are being increasingly used in certain circumstances, especially if confidence intervals or conditional tail expectations are desired as outputs from the methods applied (e.g., if used to measure risk margins).

The validity of these approaches, as with any approach, requires regular assessment, involving periodic validation. The objective is to use the method(s) considered to be the most reliable, given the experience available and appropriate expectations, rather than the blind adherence to the same approach(es) from period-to-period, although it is useful to document the reasons for any changes made.

D2.5.5 Selection of the liability methodologies applied is often based on professional judgment and may vary depending on the individual circumstances of the insurer, jurisdiction, coverage and accident year.

D2.5.6 Often a single “current estimate” scenario is developed, e.g., reflecting a single view of rates of inflation (including the influence of social, medical and general factors), current law affecting liability claims, and no mega-events of the type not already reflected in the experience data reviewed, e.g., no claims related to global warming or EMF radiation. It can exclude unusual data points, as long as the exclusion does not bias the resulting expected values and no change in claim handling compared with that of recent experience is expected.

D2.5.7 Insurance risks are often subject to skewed claim probability distributions, possibly both in terms of incidence more commonly severity, resulting in estimates resulting from a single "most likely" scenario often being less than the estimated mean value of all possible scenarios. For example, assuming

a portfolio for which a frequency/severity approach incorporates an explicit inflation assumption would be appropriate if expected inflation might be either 4% with a 75% probability, or 2% or 8% (half or twice the expected value, respectively) with probabilities 12.5% each, so that a probability weighted average (estimated mean value) of scenarios might result in an effective inflation rate of 4.25%, rather than a most likely scenario estimate of 4%. Usually a one scenario approach is only justified if the effect of the use of the entire frequency, severity or total claim cost probability distribution is not expected to result in a significantly different estimate. Given the above, a test of the sensitivity of the estimate to different assumptions can provide useful insight, through the use of probability distributions or scenario analysis, and through the use of multiple estimation methods.

D2.5.8 Extreme events (e.g., the risk of liability claims due to mass torts, radical changes in law or judicial rulings, or large single events with significant uncertainties or uncertain law/judicial rulings, such as the one or two event uncertainty relative to the 2001 World Trade Center event) can potentially contribute significantly to the estimated expected value of losses of certain coverages and markets, particularly where key data elements are unavailable at the valuation date. In certain situations, disclosure of the uncertainty in financial reporting approach is preferable to the use of insufficiently reliable estimates. Nevertheless, current estimates are usually made, even where they are subject to significant uncertainty, although the uncertainty would be appropriately be reflected in the risk margin and described in the insurer's disclosures. Note that applicable accounting standards or guidance might limit the use of such approaches.

D3 Stand ready obligation for property & casualty and other short-period contract periods

D3.1 In many jurisdictions, an unearned premium liability has been held for pre-claim liabilities. This liability is usually calculated on a pro-rata basis, depending on the time elapsed since the premium was paid (sometimes with a reduction for a pro-rata allocation of acquisition costs). If the exposure is non-linear over the contract period, the expected non-linearity can usually easily be reflected. This latter case can occur in situations with significant seasonal exposures, e.g., accident coverage of students while in school, automobile accidents during vacations/holidays or periods of high incidences of ice and snow, storm or warranty coverages by length of time since sale. In some jurisdictions, an unearned premium liability methodology may only be permissible if it can be demonstrated to be a sufficiently reliable approximation of the expected present value of risk-weighted future cash flows, considering both the uniformity of cash flows during the coverage period and that the period until settlement is similar for all claims.

D3.2 In other cases, the stand-ready (unexpired risk) obligation is determined as the current estimate of the expected value of the present value of risk-weighted future cash flows for future claims associated with the ultimate settlement of those claims. This reflects the current value of the unexpired risk for the remainder of the contract period, less any applicable expected premiums. Similar to a longer-term insurance contract, it is based on an expected value of the cash flows associated with the contract remainder, also reflecting present values and an adjustment for risk. In some cases, payment of future premiums for the remainder of the contract period may be enforceable in non-life insurance; such enforceable rights relieve any concerns regarding the recognition of the premiums. For most cases in which renewal premiums are not under control of the insurer, an initial asset would be recognized excluding those expected to be uncollectible, although no renewal premium would be recognized, depending on the accounting standard and guidance. In many jurisdictions (as required by IFRS 4), this current value is used in a Liability Adequacy Test (LAT) when the basis for the stand-ready liability is the unearned premium.

D3.3 Many of the same factors as given in Section 4 of this paper apply to the determination of the expected values used as a basis of this liability. Some differences may include:

- The expected cost of catastrophes for the unexpired risk period would be reflected for the remainder of the current contract period, while in most cases the emergence of a catastrophic claim is usually recognized at an early point in time as a cohort of claims are incurred.

- A liability adequacy test (LAT) would not be needed, as the calculations involved already inherently incorporate these expected values. However, a LAT would be required if current assumptions are not used.

D4 Expenses (other than loss adjustment expenses)

D4.1 Expense assumptions reflected in the expected value of future cash flows reflect future expenses associated with obligations arising from commitments the entity has made through the valuation date. These might, depending on the financial reporting standards and guidance, include some or all allocated overhead expenses.

D4.2 The types of expenses included can differ depending on the financial reporting standard under which the application applies. Incremental (marginal to the contract) expenses are often used if the unit of account underlying the entity's accounting policy is the contract, for example as in IAS 18 and 39. In contrast, some argue, as does paragraph 180 of the IASB Discussion Paper, that a contract could not be sold without considering full overhead expenses. If the portfolio is used as the unit of account, variable expenses (probably including allocated indirect expenses) would be used, e.g., as in U.S. GAAP SFAS 60.

Paragraph 62 of the IASB's Discussion Paper indicates that in practice, although a market clearing expense level might be a more theoretically sound assumption, "the Board expects that an insure would use estimates of its own servicing costs, unless there is clear evidence that the insurer is significantly more or less efficient than other market participants. And even then, if the entity is more efficient than a market participant, it is unlikely that the purchaser or transferor would take steps to increase the entity's expense level.

D4.3 Some applications, including the IASB's preliminary views on phase 2 of its Insurance Contracts project, might also consider the expected profit margin inherent in market prices charged by a third party provider (outsourcer), reflecting the profit margin for providing a service related to the expected cash flows considered. Using the portfolio as a unit of account in those cases would permit some economies of scale to be reflected, including at least a level of overhead that could be included in the price for the service. If an entity-based measurement is used, e.g., as in many current reporting standards, all relevant overhead would be allocated and included in current estimates.

D4.4 Since significant differences can exist in the development of expense assumptions in different accounting standards, it is important to understand the accounting basis for which those expense assumptions will be applied. For example, the IASB in its Insurance Contracts Phase 2 project has not

yet determined whether portfolio-specific, entity-specific or market-based measurement of expected future expenses is a more appropriate base. Even though portfolio-specific measures are apparently preferable, i.e., expense assumptions reflecting servicing needs of the portfolio measured rather than the service capacity of the entity, most insurance professionals favor entity-specific expense measures, as it is available, and is easier to measure and calibrate. In large part this is because it can be quite difficult to determine what applicable third-party costs would be for the product and service mix of a portfolio or entity and in most cases no reliable or relevant industry-wide inter-entity or market-based expense benchmarks are available.

D4.5 If an entity-specific basis is used in setting expense assumptions, it may be useful to take into account:

- The entity's range of products and services provided, including the level of maturity of the portfolio;
- The entity's strategy for determining the level of service provided to policyholders and cost of the entity's infrastructure (and its approach to claim management for LAE, if applicable); and
- The entity's efficiency in providing that level of service (and implementation of its claim management approach, if applicable).

D4.6 An important element in the analysis of entity-specific or portfolio-specific expense experience data is the allocation of expenses. Important allocation categorizations include coverage or line of business, and between first year and renewal (or inforce) expenses, for which the latter is more relevant to long-duration contracts.

D4.7 The level of service and approach to servicing policyholders will usually affect both expense levels and voluntary contract termination and renewal rates. The cost of managing the entity's infrastructure can also be indicative of the entity's efficiency, although it can be argued that it is at least as indicative of the level of service expected in the price charged for a contract. For established entities, sufficient data is usually available for expense assumptions to be determined on a portfolio-specific basis. If practical, when developing a non-portfolio specific assumption, the entity's business strategy to achieve the desired level of service to policyholders (and its approach to claim management) can be taken into account. Its operational and service-level strategies indicate that whether an entity may be more or less efficient than other market participants, while the expense assumption normally reflects the general level of efficiency in the market.

D4.8 The use of a portfolio- or an entity-specific approach on an expected value basis implies that it is appropriate to reflect, or at least consider, management plans to improve the efficiency of its existing service level and claim management strategy incorporated in the assumptions. Historically,

allowance for the effect of projected improvements has usually been taken into account only when there is clear and objective evidence that it is appropriate to do so, that is, only to the extent that management has already developed specific plans and has a track record of being able to carry out such plans. In any case, the expense needed to execute such changes would be considered, as well as expected improved ultimate level of expenses. It is usually difficult to verify in advance that projects will achieve an improvement exceeding its cost, considering the large number of such projects that ultimately do not result in improved expense efficiency.

D4.9 All relevant administrative cost and applicable commissions would be estimated, although depending on the applicable financial reporting standard, only contractually-linked expenses are recognized in the measurement of the liabilities. Depending on the entity's accounting policy, if the unit of account is the portfolio or the entity, variable expenses or even general overhead expenses might be included. Where future deposits or premiums are incorporated into the measurement of insurance liabilities, expenses related to those deposits or premiums would also be taken into consideration. In addition, where appropriate the expenses of administering investments and related expenses could be taken into consideration in the determination of the discount rates.

D4.10 In developing assumptions regarding future cash flows, one-off expenses during the experience period would usually be eliminated. However, such expenses would be reviewed carefully, since many entities can incur similar in size but different in nature one-off expenses on a regular basis. In any event, small one-off expenses would not be adjusted for, as these types of expenses usually will reoccur, even though due to different circumstances. However, it would not be appropriate both to deduct the current investment in a new administrative system while at the same time to reflect the cost savings that are expected from the system’s implementation. Such adjustments from recent historical expense levels can go both ways; for example, a producer convention may not be held every year – in the year that one is not held, such expense may have to be added to that of the experience period.

D4.11 Subject to specific market conditions, expense assumptions for long-duration contract portfolios normally assume that the entity will maintain a reasonable level of new business and, therefore, the assumptions for the closed book, i.e., the book of policies in-force at the measurement date, would ordinarily be based on the current level of economies of scale.

D4.12 Even when the entity's accounting policy indicates that entity-specific expense assumptions are used, in situations such as a start-up or wind-down of an entity, or where the allocation of expenses is unusual, available expense data may not serve as an appropriate basis for projecting future

expenses. Normally in such a case it is appropriate to examine the experience data carefully so that the resulting assumptions provide for a reasonable level of future expenses consistent with the administration of contracts, investments, and claim settlement, and that satisfy the objective of the valuation. If a reliable steady-state expense data base is not available, alternative sources will have to be used or developed, e.g., industry studies if any, reinsurer advice (particularly for start-ups), third-party administrators specializing in run-off books of business in the case of a wind-up operation, or the entity's pricing assumptions.

D4.13 Future inflation-sensitive expense cash flows are usually assumed to vary with the assumed rates of general level of expense inflation in a reasonable manner. The starting point is normally the current level of inflation, with subsequent inflation assumed to reflect the expected relationship between inflation and future interest rates. A factor is then normally be added to reflect the issuer's level of unit expense trend relative to the market level of price inflation, when justified by the relative nature of the entity's business relative to that underlying observable market data, often consistent with assumptions of future interest rates. In some jurisdictions, technological efficiencies and market growth have more than offset general inflation in the trend in unit operating expense. However, if the unit metric used is based on the number of contracts, this net productivity improvement has been far more difficult to achieve. As different types of expenses are sensitive to inflation to differing extents (e.g., commission expense that is determined by formula in contrast with wage and benefit costs, which has often increased faster than general inflation), different rates of expense inflation may be associated with different types of expenses, although this applies only if discount rates are based on the entity's expectations.

D4.14 Where external parties provide services, such as for policy administration or asset management, consideration is given to the terms of these agreements, including the possibility of their termination.

D4.15 Relevant expenses of the entity's holding entity or a related entity providing inter-group service would also be reflected, although if a measurement approach that relies on market prices is used (i.e., including a service margin), the equivalent cost available from the observable market place of the amounts charged by an independent third-party or transfer costs used for tax purposes (transfer price) might be appropriate. In the case of consolidated group financial statements, such inter-group charges will not have an effect, and the liability measurement has normally been based on the total actual expenses of the group, not necessarily what is charged.

D4.16 The expenses charged to the entity by a guarantee fund (whose purpose is to provide benefits to policyholders of entities who for financial reasons cannot pay them) in a jurisdiction are a necessary cost to many insurers.

This is usually based on an allocation of these costs allocated to the entity, often a function of prior business volumes of an entity. Although not a cost directly associated with the portfolio, it is generally felt that it is a cost of being in business and thus the expected charges, based on expected recent changes in volume of the entity, the cost of recent bankruptcies of other insurers, and expectations regarding future volumes and insurer bankruptcies would be reflected in the aggregate expense assumption.

D5 Policyholder behavior

Especially for certain long duration contracts, the effect of the election of policyholder options is important to reflect in the current estimate. If the measurement of the liability is unconstrained by the applicable financial reporting standard (i.e., some accounting systems do not permit certain policyholder behavior assumptions to be used at all), it would be appropriate to reflect the expected effect of the expected use of these options. See Section 4.1.6 of the paper for further discussion of consistency of assumptions. Special consideration would be given to apparently irrational policyholder behavior, since fundamental economic theory and models are based on the assumption of rational behavior.

Options available to the policyholder can include the termination of a contract (contract discontinuance rates, sometimes referred to as lapse or surrender rates) and use of non-forfeiture benefits where available, payment of scheduled or non-scheduled renewal premiums use of guaranteed insurability features, policy loan utilization, contract exchange, or other contractual options including guaranteed living benefits such as annuitization, guaranteed insurance options, partial withdrawals (partial contract discontinuance, either of a portion of the benefits or account values), and guaranteed income benefits. Their use can be particularly affected by other contract features and external conditions and insurer behavior, including being sensitive to interest rate levels or option costs such as surrender charges.

Some financial reporting standards require, for the purpose of estimating liabilities that rational financial behavior by policyholders that would result in the most disadvantageous effect for the insurer. However, it can be difficult in some cases to determine which the worst case is, considering the expected effect of anti-selection and moral hazard, particularly when current or future guaranteed insurability is involved. Examples of such situations include lapse-supported products (those in which the insurer can increase its expected profitability if greater voluntary terminations occur, such as long-term care contracts without cash values and with a very steep expected cost curve) or even 100% lapsation in certain cases, which may not be realistic and would be inconsistent with current estimates. The worst case often would arise if all healthy policyholders terminate their contracts

and all those with significant physical impairments remain. Realistic current expectations would incorporate at least some policyholder action or inaction that is not within their expected best interest (e.g., due to convenience, forgetfulness or loyalty to a producer). Alternatively, what might appear to be irrational behavior to external parties might be consistent with rational risk preference or the policyholder situations.

D5.1 Extent of rational behavior

D5.1.1 Based on observation, not all policyholders behave in what appears to be a rational financial manner. Unless constrained, expected assumptions can reflect that the extent of rational behavior is limited. For instance, even if insurance or investment guarantees are significant, certain policyholders will discontinue their contract in any event due to many reasons, including changes in their individual circumstances that the insurer will be unable to observe, or the existing policy will be exchanged for another that a producer of another entity presents to the policyholder. In contrast, other policyholders will continue to pay premiums whether or not they remain in need of the protection, in some cases as a result of having them automatically deducted from their checking account or from pure inertia.

In addition, because of fear of lack of current or future insurability or the focus on expected future contractual guarantees that might not currently be in-the-money, expected policyholder behavior, particularly on an individual basis, will be rarely lead to 100% termination. This behavior under a range of scenarios can be difficult to estimate.

The extent or quality of customer service level or perceived brand value, both entity-specific factors, can influence many policyholder behaviors.

D5.2 Discontinuance rates

D5.2.1 For most contracts, contract discontinuance assumptions are estimated, since the entity is exposed to risk from the potential use of the policyholder options to withdraw or persist, and if termination is decided upon to select the timing or the amount of such contract termination. Discontinuance can result from ceasing premium payments (this does not mean that the reporting entity's liability is necessarily eliminated at that time) or terminating the contract. Discontinuance can give rise to such action as the payment of surrender or transfer values, the exchange for a paid-up policy, or to a lapse without value.

D5.2.2 For most one-year contracts, a more common issue is the possible renewal of the existing contract. In most financial reporting standards, these renewals are not considered to be part of the existing contracts and they are not recognized (though in a business combinations, related

customer intangibles are recognized in some accounting models). Even in this case, the primary attribute recognized would be non-level claim costs across renewal periods.

D5.2.3 The following are some considerations that can affect expected discontinuance assumptions. Most of these factors are portfolio-specific, although some are applicable on an entity-specific or type of product-specific basis, with many the result of contract features, policyholder characteristics, and overall conditions that affect the market or overall industry.

- Benefits and options provided through contract features;
- The way the contracts were sold and marketed (e.g., a universal life contract sold as low premium term insurance or primarily for investment purposes)
- Contract duration, attained age and gender;
- Premium frequency and payment method and mode;
- Premium paying status;
- Size of contract and current, expected future, and changes in the financial condition of the policy owner;
- Relative advantages of lapsation/withdrawal and persistency to the policyholder (e.g., due to insurability, current or anticipated tax and other benefit situation);
- Incentives, such as pattern of surrender charges (especially the end of a surrender charge or conversion period) and/or persistency bonuses;
- Sophistication and price-sensitivity of the policyholder and intermediary;
- Expected extent of competition for the product;
- Interest rate scenario and other economic factors (particularly for so-called “interest sensitive contracts”);
- Insurer behavior and decisions, e.g., timing and amount of bonus/dividend distribution compared to expectations and competition, service level provided, non-guaranteed elements credited or charged, interest rate credited compared to that available elsewhere;
- Distribution system, type of producer, and other marketing practices applied;
- Claim management practice, particularly for non-life coverages;
- Culture, such as the contrast between the very low annuitization rates in certain Western countries (e.g., the U.S.) and certain East Asian counties (e.g., Japan); and
- Expected changes in aggregations as a result of changes in the entity’s portfolio mix.

D5.2.4 If not guaranteed, the measurement of the surrender value payable on contract discontinuance, the following will usually be taken into account:

- Market and non-market assumptions applied in the projection;
- Any guaranteed surrender or transfer value scale; and
- Constructive or discretionary obligations provided for within the contract.

D5.2.5 Discontinuance experience normally has a significant effect on overall profitability to the issuer of many insurance and investment contract types, particularly its effect on expected future margins that exist to recover initial acquisition expenses and to compensate for the risk and service provided. To the extent practical, relevant and reliable discontinuance experience is used. In the absence of reliable experience data for the class of risk under consideration (e.g., new products or later durations in the policy), other comparable sources would normally be considered. These assumptions usually have to be portfolio-specific, reflecting other factors, including product and risk characteristics such as age.

D5.3 Other optionalities

D5.3.1 The cash flows of a contract can be affected by the use of policyholder options.

D5.3.2 Future premiums. The most commonly offered policyholder option is payment of future premium payments or deposits.

D5.3.2.1 These premiums or deposits may be regularly scheduled or their amount and timing can be flexible, e.g., for many universal life contracts. These latter include dumps or irregular premium paying patterns and partial withdrawals, which are separately estimated if the accounting standard provides for the effect of the expected pattern of use of these policyholder options.

D5.3.2.2 Other premium option features include automated premium increase acceptance where the policyholder has the right to not accept an automatic increase in an indexed policy or premium holidays in a pension contract.

D5.3.2.3 These are generally not under the control of the insurer, so may be considered by some financial reporting standards as intangible embedded assets. However, in most cases they are recognized in the measurement of future cash flows anyway, as they may be considered an integral part of the insurance contract.

D5.3.3 Other. Other examples of policyholder options that may or more not have associated costs to an insurer include:

- annuitization (often of deferred annuities, but also possible as a form of settlement of a life insurance death or maturity benefit);
- conversion of a term insurance contract for a permanent life insurance contract,

- allocation of account values among alternative asset funds,
- exchanges of one life insurance contract for another of a different or similar type, without or without evidence of good health,

D5.3.6 In many cases, the effect of the use of these options is asymmetric in nature. Although closed form solutions or other bases for developing estimates may be developed or possible to be developed, a set of representative or stochastically generated scenarios may be just as or more appropriate to use in the calculations involved in some cases.

D5.3.7 Depending on cash flow expectations, the effect of this behavior can be restricted by the form of contract. For example, depending on the financial reporting rules, renewal of one-year contracts may not be recognized, although the probabilities may be the same as if the contract were written in a perpetual form (with or without conditions). A different treatment may apply depending on the ability of the insurer to change premiums or when future premiums are not specified in the contract.

D5.3.8 The expected behavioral affect on utilization and cost of any deductibles, coinsurance or experience rating arrangements on claim experience of health insurance and some property & casualty insurance contracts.

D5.3.9 Other policyholder options may or may not have costs associated with them. These can include:

- Use of policy loans, including the right to take out or change the amount of the loan and the right to specific conditions of a loan;
- Add a new family member to an existing contract, either at a guaranteed or current rate;
- Change or add insureds, insured properties, beneficiaries or owners;
- Change the form of contract or feature of a contract, e.g., from a with-profit to a not-for-profit contract;
- Choose or change coverages and amounts in a group plan by an employee or participant;
- Reset conditions or terms of guarantees, e.g., segregated fund resets;
- Choose or change the form of dividend payouts, e.g., cash, paid up additions, term insurance, and accumulations;
- Change the Bonus Anticipation Rate;
- Choose a lump sum payment or an annuity form at retirement or other annuitization date;
- Choose annuity payout forms other than single life (systematic withdrawal, joint and survivor, fixed period, etc.) at retirement or other annuitization date, where the benefit is a fixed percentage of the benefit for a single life;
- Choose the timing of retirement or other annuitization date;

- Accelerate benefit payments in the event of a dread disease; and
- Utilize a free-look provision, e.g., right of return of a policy in the thirty days after a sale, or otherwise rescind a contract.

D6 Other assumptions

D6.1 Insurer behavior

D6.1.1 Insurer behavior can affect the delivery of certain contractual elements for which discretionary action or the method of delivery is allowed or inherent in the product or service provided. These can include policyholder dividends/bonuses, charges, fees or interest credits. For some products, the interest crediting process (the interest rate guarantees or the amount credited in excess of the guarantees) can become complicated, e.g., a deferred annuity contract may be assigned 24 or more interest rate crediting buckets corresponding to when the corresponding premiums (or deposits) were received, all associated with a different interest rate. In this case, deriving reasonable behavior estimates under each practical scenario can be quite complex. In addition, insurer behavior can affect the expenses allocated to provide insurance risk services, such as the method of handling claims.

D6.1.2 If this behavior is restricted, for example by law, regulation, constructive obligations, or contract a single set of behavior is assumed to be consistent with the applicable restrictions, although it might vary by scenario. Alternative behavior may also be reflected if appropriate (on either a deterministic basis, or if asymmetric risks/costs are involved, using stochastic or representative sets of behavior consistent with economic and demographic characteristics).

D6.1.3 Contractual constraints on insurer behavior include a wide variety of guarantees embedded in an insurance contract. These vary significantly by type of insurance, contract and jurisdictions. They can include such guarantees as:

- Contract continuance and renewal, based on guaranteed or market rates;
- Premium, charge and fee guarantees or maximums;
- Cash, non-forfeiture, capital (principal), and maturity values, either in terms of absolute amount or a value based on current conditions;
- Minimum benefits or credited or committed credited investment earnings;
- Annuity benefits, e.g., conversion rates, annuitization assumptions (e.g., mortality table), and death, withdrawal, living or income benefits;
- Guaranteed future insurability benefits, in the form of ability to purchase additional insurance or maintain currently determined benefits; and

- Immediate coverage after application signature.

D6.1.4 Changes in corporate strategies or risk management techniques, whether in response to changes in conditions or management, would be reflected as they emerge or in certain cases as they are implemented successfully.

D6.1.5 Constraints to the recognition of the effect of this behavior is common, possibly as a result of contract features, legal requirements, or constructive obligations. Insurer behavior can also be prescribed based on its board resolutions or entity policy.

D6.1.6 Insurer behavior can affect future insurer expenses, in terms of efficiency and effectiveness of operations of almost all of its functions, including those related to claim administration.

D6.1.7 An insurer can change its investment strategy, including its asset/liability management objectives, and the way they are achieved. These often change in response to asset availability and products sold and inforce.

D6.1.8 Applicable financial reporting standards may require certain assumptions regarding expected behavior.

D6.1.9 Expected consequential policyholder behavior would be consistent with assumed insurer behavior. In addition, assumed insurer behavior would be consistent with the other assumptions selected.

D6.2 Reinsurance considerations

D6.2.1 In general, the counter-party to a reinsurance treaty is assumed to be knowledgeable about the contingencies involved. For example, it is usually assumed that the counter-party will exercise the terms of the agreement to its financial advantage, e.g., its ability to exercise contractual changes, usual and customary practices within the industry, and past practices of the parties involved. This can include recapture or commutation of a treaty, payment of a reinstatement premium to restore reinsurance protection, rating trigger of an action if a reinsurer's rating decreases to a certain level, change to the current scale of reinsurance premiums or expense allowances that may be dependent on the scenario of cash flows, and recapture options.

D6.2.2 Counter-party credit (non-performance) risk. The payment history, credit rating, risk-based capital ratios or other available relevant information about a reinsurer are taken into account in determining the probabilities of expected reinsurance recoveries that affect the measurement of the reinsurance asset. The extent that these factors are considered in the

insurance liability or reinsurance asset will depend on the accounting standard for reflecting this risk.

D6.3 Other assumptions

Other assumption not described in this paper include morbidity and recovery rates for contracts involving health insurance, rates and amounts of salvage and subrogation, longevity rates for pure endowments, annuitization and conversion rates.

APPENDIX E – The IAA ad hoc Risk Margin Working Group Background

This appendix addresses the background of the IAA's ad hoc Risk Margin Working Group (RMWG), its Terms of Reference, and the process it has followed to develop this paper.

E1 Background

The International Actuarial Association (IAA) has, from its earliest days, endeavored to work cooperatively with both the International Accounting Standards Board (IASB – and its predecessor the International Accounting Standards Committee, IASC) and the International Association of Insurance Supervisors (IAIS).

When the IASC launched its project to develop a new international accounting standard for insurance contracts in late 1997, the IAA accepted the IASC's invitation to participate in the IASC Insurance Steering Committee and formed its own IAA Insurance Accounting Committee to liaise with the IASC. Later, the IAIS became involved in the IASC's insurance accounting project and launched its own project to establish Core Principles of insurance regulation and related regulatory guidance and standards. The IAA increased the remit of its Insurance Accounting Committee to cover both insurance accounting and insurance regulation issues.

It rapidly became apparent that the amount of activity in the accounting field and in the regulatory field was so large that the IAA would need two separate committees to deal with the two aspects of the rapid international developments in the insurance field. The IAA Insurance Committee was split into the IAA Insurance Accounting Committee and the IAA Insurance Regulation Committee. Bearing in mind the commonality of issues faced by the two IAA committees, the IAA developed a tradition of having a joint session in which the members of the IAA Insurance and Regulation Committees met as a "committee of the whole" during the committee meetings accompanying the biannual IAA Council meetings. One of its purposes was to ensure that each of the IAA committees that liaised with the other international organizations involved with insurance, the IASB and the IAIS, was aware of both the emerging issues facing and actions of the other relevant IAA committee.

By the time of the International Congress of Actuaries in Cancún in 2002, the IAA Insurance Accounting Committee was faced with the desirability of developing International Actuarial Standards of Practice (IASPs) for use in conjunction with what was to become IFRS 4, the first phase of the IASB's

insurance contracts financial reporting standard. Shortly thereafter, the IAA Insurance Accounting Committee formed its Actuarial Standards Subcommittee to deal with the development of these IASPs.

Similarly, the rapid evolution of the IAIS led to the establishment of several new subcommittees, including ones focused on insurance financial reporting and insurance solvency issues. The IAA reacted by establishing the IAA Solvency Subcommittee of its Insurance Regulation Committee to assist the IAIS in developing a possible new framework for international insurance regulation by the IAIS. In 2004 the IAA Insurer Solvency Assessment Working Party produced a comprehensive research report, "A Global Framework for Insurer Solvency Assessment," often called the *Blue Book*, which, in large part, helped to form the conceptual foundation underlying future IAIS solvency developments.

The adoption in March of 2004 by the IASB of IFRS 4, the first phase of its insurance contracts financial reporting standard, caused both the IAA and the IAIS to reinvigorate their respective efforts to interact with the IASB. The IAIS formed an Accounting Subcommittee to deal with overall insurance issues and an Insurance Contracts Subcommittee to deal with the specific issue of liability measurement for financial reporting purposes, while strengthening the mandate of the IAIS Solvency and Actuarial Issues Subcommittee ("Solvency Subcommittee") to develop the strong framework for regulating the solvency of the international insurance industry.

The practice developed that the IAA was represented at the IAIS Insurance Contracts Subcommittee by the co-vice-chairpersons of the IAA Insurance Accounting Committee. At the same time, the IAA was represented at the IAIS Solvency Subcommittee by the chairpersons of the IAA Insurance Regulation Committee and its Solvency Subcommittee.

In early 2005, the IAIS Insurance Contracts Subcommittee undertook to develop the IAIS's First Liabilities Paper in which key issues were raised with the IASB concerning a possible measurement template from which the IASB could adopt standards for the measurement of liabilities for insurance contracts for general purpose reporting purposes that the IAIS could use as a basis for regulatory purposes. The co-vice-chairperson of the IAA Insurance Accounting Committee, acting as liaison to the IAIS Insurance Accounting Committee, was an active participant in the development of this IAIS paper, adopted in Beijing in late May 2005.

In developing this paper and its solvency regime, it quickly became apparent that the key issue, without which a common IASB / IAIS liabilities measurement template could not be developed, was what risk margins above current estimates would be included. In other words, in the development of an IAIS Solvency regime based on the "total balance sheet"

(sometimes called "total financial resources") concept as proposed in the *Blue Book*, what part of the total financial resources objective should be included in liabilities?

This led the IAIS's Solvency Subcommittee to discuss how to proceed in its meeting in Tokyo held on May 30 to June 1, 2005, which in turn led to its draft of a Terms of Reference (ToR) describing how the IAA might assist the IAIS in the area of risk margins. The draft ToR were discussed at the joint meeting of the IAA's Insurance Accounting and Regulation Committees in Rome on June 15 2005, attended by key IAIS personnel, at which it was agreed that the IAA would form an ad hoc Risk Margin Working Group (RMWG) co-chaired by leaders of the IAA's actuarial standards and solvency subcommittees, Paul McCrossan and Henk van Broekhoven, with its membership initially drawn from the relevant IAA committees and subcommittees, while being open to other interested actuaries as well. The RMWG's final Terms of Reference is included in Section E2.

The IAIS subcommittees met in Basel at the end of September 2005; followed immediately by the first face to face meeting of the IAA's RMWG to finalize its Terms of Reference and the process it would follow.

E2 Terms of Reference

In mid-2005, the RMWG began its deliberations to provide assistance to the IAIS in its development of approaches to establish a regulatory framework under which the liabilities for insurance contracts (*technical provisions* as often referred to in a regulatory context) should be measured. Included prominently was a request for assistance with a key element of these liabilities and provisions, the risk margins. The formal title of the IAIS request is "Approaches to the Determination of Liability Values and Quantitative Benchmarks for Technical Provisions" included in its Roadmap Paper (2006). To carry out this request, the following Terms of Reference was adopted by the IAA's ad hoc Risk Margin Working Group (RMWG).

E2.1 Scope

"Issues related to the determination of best estimate policy obligations and technical provisions, and assessing the adequacy thereof, in the context of an insurer's total balance sheet."

E2.1.1 Note regarding terminology

At the time that the IAA received its reference from the IAIS, the IAIS used the term "best estimate," rather than "current estimate" as used in this paper. Subsequently, in 2006 in *Issues arising as a result of the IASB's Insurance Contracts Project – Phase II* (known as its Second Liabilities

Paper), the IAIS adopted the terminology “current estimate” to refer to the unbiased estimate of future cash flows reflecting the time value of money, defined as "the expected present value of probability weighted cash flows using current assumptions." Similarly, in the same paper the IAIS introduced the term “margin over current estimate (MOCE)” to refer to the margin reflecting the level of uncertainty in the calculation of the current estimate.

In this paper, the RMWG has adopted the use of the term “current estimate” and “risk margin” as standard terminology, although the latter is frequently referred to as a "risk margin over current estimate" or, for short, "margin" for brevity. "Current estimate" in some jurisdictions has been referred to as "central estimate" or "best estimate."

Note that, in other professional literature, the “current estimate” concept sometimes includes both concepts. In this paper, the liability for insurance contracts consists of the combination of the current estimate and the risk margin.

E2.2 Objective

“To provide detailed insight into current practice, challenges and solutions in relation to how actuaries determine best estimate policy obligations and technical provisions in a number of major insurance markets, approaches to determining their adequacy, the reliability and robustness of the different methods used and quantitative benchmarks to enable appropriate comparisons across insurers and jurisdictions.”

E2.3 Aim

“To assist the IAIS in defining

1. the role and purpose of best estimate policy obligations, risk margins and hence technical provisions in the context of both solvency assessment and public financial reporting, and the likely areas of difference between these two contexts;
2. principles and approaches that are appropriate for the determination of best estimate policy obligations, risk margins and hence technical provisions; and
3. measurable standards for assessing the sufficiency of best estimate policy obligations, risk margins and hence technical provisions in a manner that will allow supervisors *to:*

    a. readily assess the prudential risk margin above best estimate policy obligations that is included in the technical provisions of insurers and the reliability of an insurer’s history in making prudent assumptions in determining its risk margins;

b. determine the differences in sufficiency of technical provisions between entities and enable comparison across jurisdictions; and

c. monitor the movement of prudential risk margins against changing market conditions, ensuring that, if pro-cyclical behavior exists, it can be arrested before insurers become vulnerable to failure."

E2.4 Supervisory reporting objectives

"As part of the common structure and common standards for the assessment of insurer solvency, to support transparency and convergence and enhance the comparability of insurers worldwide, … should support a supervisory reporting regime for technical provisions that will enable, for example:

1. reporting of technical provisions analyzed between best estimate policy obligation and prudential risk margin by line of business, covering life and non-life sub-sectors;
2. reporting of these components for a sufficient period (such as the previous five years) in order that triangulations in both components can be derived and thus assumptions validated; and
3. further analysis as appropriate by geographic location and, for reinsurance, by type of contract."

E2.5 Supervisory convergence problem addressed by the RMWG

"The terminology for and definition of best estimate policy obligations, risk margins and technical provisions, and the methods and approaches used to determine them, varies across and within jurisdictions. Further, there are different views regarding the reliability and robustness of the methods used and amounts determined using currently available approaches, techniques and data."

E2.6 IAA input requested

"In the context of insurer solvency assessment for supervision purposes, on:

- elements/risks that should be allowed for in the quantitative determination and valuation of best estimate policy obligations; technical provisions and risk margins;
- principles, methods and assumptions that are available for determining these values;
- specific issues or considerations related to any particular products or classes of business; and

- data and other requirements needed to enable the determination of reliable and robust values for supervision purposes."

E2.7 Relevant considerations

"The IAIS would anticipate that relevant considerations would include, but not be limited to:

- risks for which quantification/valuation is appropriate and reliable
- techniques, methods and models used and their calibration, reliability and robustness
- allowance for aggregation, correlation and risk interdependency
- detailed line of business discussion of issues and assumptions involved in determining and reporting both best estimate policy obligations and prudential risk margins (including reliability, volatility and availability of data).
- allowances for guarantees, bonuses and other embedded options
- effects of changes to reinsurance buying patterns (gross and net valuation and reporting).
- discount rates
- claim rates, amounts and settlement expenses
- materiality considerations."

E3 Process followed

Prior to the issuance of an initial exposure draft of this paper, the RMWG held five face-to-face meetings, in September 2005, and January, March, June and November 2006. It also had frequent exchanges of e-mails and conference calls between meetings.

In addition, selected (co- and vice-) chairpersons of the IAA's Insurance Accounting Committee, Regulation Committee and Solvency Subcommittee attended the meetings of the IAIS Insurance Contracts Liabilities and Solvency Subcommittees. Similarly, IAIS representatives attended RMWG meetings, as well as IAA's Insurance Accounting, Insurance Regulation and Solvency meetings during this period.

In part due to the lack of IAA paid actuarial staff, the RMWG decided at its first meeting that it would rely upon research that it was aware that:

- had been conducted by the IAA in the past and was capable of modification to help meet the IAIS objectives;

- was conducted or being conducted by its member organizations; or
- was conducted or being conducted by members of the RMWG.

The initial request from the IAIS was for a preliminary version by the end of 2005 and for a final paper by the middle of 2006. It was quickly determined that it would be impossible to produce a preliminary version of the paper by the end of 2005. Nevertheless, the IAA representatives to the IAIS Liabilities and Solvency Subcommittees were able to provide input to those subcommittees as they developed the IAIS's *Second Liabilities Paper*, the IAIS's *Roadmap Paper* and the IAIS's *Common Structure for the Assessment of Insurer Solvency* (*Common Structure*) Paper that reflected the developing RMWG research. Much of that input made its way into the work on these projects.

In addition, the paper's scope has been somewhat generalized to provide a more rigorous context, in parts by addressing both regulatory and general purpose financial reporting issues and examples and by expanding somewhat in a few areas, such as discount rates where deemed appropriate.

A three month period was provided for public comments. Twenty six written comments were received during or immediately after that period, copies of which are posted on the IAA website. Subsequently, a meeting of the RMWG was held in London in June and in Dublin in November 2007 to discuss these comments and the way forward. This is the revised version resulting from those discussions that is being re-exposed for further comments.

The original co-chairs of the RMWG were Paul McCrossan and Henk van Broekhoven, although after a significant contribution, Paul retired from this service prior to the distribution of the original Exposure Draft. Subsequent to Paul's retirement, a small drafting team was formed, consisting of Kris DeFrain, Sam Gutterman, Allan Kaufman, Francis Ruygt, and Henk van Broekhoven. Members of the working group include Tony Coleman, Philipp Keller, Arne Sandström, Masaaki Shigehara, Therese Vaughan, and Peter Withey. Input from interested parties, in some cases considerable, have been reflected in the paper throughout the process. These have included, but are not limited to, Ralph Blanchard, Bob Buchanan, Peter Clark, David Congram, Stefan Engeländer, Matt Saker, Henry Siegel, and Martin White.

TABLES AND CHARTS

GLOSSARY

- **Assumption** (an estimate of an element of a liability). An input parameter used in an estimation model to measure actuarial items, such as liabilities for insurance contracts or economic capital for an insurer.

- **Asymmetry**. The extent to which a probability distribution deviates from a symmetric form (with equally weighted sides around the mean.

- **Best estimate** (also see *current estimate*). Usually refers to as a best available estimate of an expected or mean value (i.e., probability-weighted average of all possible outcomes), which is the interpretation taken in this paper. In some circumstances can refer to the most likely outcome or include a risk margin as in IAS 37.

- **Blue Book** (see *A Global Framework for Insurer Solvency Assessment)*.

- **Calamity risk** (also referred to as *catastrophe risk*). The risk associated with an extreme loss event or series of outcomes. Associated with the extreme right tail of a probability distribution.

- **Capital**. The amount of resources available in excess of the entity's liabilities, sometimes referred to as the net assets of the entity. *Economic capital* is the capital needed by the insurer to satisfy its risk tolerance and business plans which is determined from an economic assessment of the insurer's risks, the relationship between them and the risk mitigation in place. [IAIS, *Guidance Paper on Enterprise Risk Management*, Draft 1 July 2007, footnote 15, page 12] *Regulatory required capital* is the minimum amount of capital an insurance entity needs in order to remain in business without a regulator requiring an adverse action, such as taking control of the entity.

- **Conditional tail expectation** (*CTE*, also referred to as *Tail Value at Risk* (*TailVaR*)). The conditional expected value of that part of a probability distribution that lies above a given quantile.

- **Confidence level method** (see *quantile method*).

- **Cost of capital**. The opportunity cost associated with a given amount of capital.

- **Cost of capital method**. An approach used to estimate risk margins that is determined based on the cost of holding the capital needed to perform the obligation.

- **Credibility**. In actuarial literature, it is the extent that a given set of information can be used or relied upon for the purpose of estimation. In its application, information from a first source of information is given a certain weight, while external or other information is given its complementary weight (one minus the first weight).

- **Current entry value**. The amount a policyholder would have to pay to an insurer at a measurement date if the policyholder would acquire a new contract of a similar nature for its remaining lifetime at that point in time.

- **Current estimate**. The unbiased estimate of future cash flows, considering all currently available information, that reflects the time value of money.

- **Discontinuance rate** (also referred to as *surrender rate*, *lapse rate*, or *policy termination rate*). The probability of a policyholder terminating a contract, usually on a voluntary basis. The conversion of the contract through a non-forfeiture option is usually included in this probability.

- **Diversification**. A risk mitigation technique that combines different types of risks in a way that reduces the risk associated with a portfolio.

- **Economic value** (see *capital*).

- **Estimate**. An approximation, in the absence of an exact measurement.

- **Exit value**. The amount an insurer would expect to pay or receive at the current date if it transferred its outstanding rights and obligations under a contract to another entity.

- **Explicit assumption method**. An approach used to estimate risk margins included in the measurement of a liability in which margins are estimated for each major assumption under risk explicitly.

- **Extreme event risk** (also referred to as *catastrophe risk*). The risk of occurrence of outcomes with unusually high severity, usually with a very low probability of occurring.

- **Fair value**. The amount for which an asset could be exchanged or a liability settled, between knowledgeable, willing parties in an arm's length transaction. [IAS 32.11]

- **Financial risk**. The risk that the market assessment of the value (its price, including applicable time value of money) of an item changes, without reflecting a change in the item itself: "The risk of a possible future change in one or more of a specified interest rate, financial instrument price, commodity price, foreign

exchange rate, index of prices or rates, credit rating or credit index or other variable, provided in the case of a non-financial variable that the variable is not specific to the party to the contract." [IFRS 4, Appendix A]

- **General insurance** (also referred to as *property & casualty insurance* or *non-life insurance*). Insurance covering property and liability risks. Sometimes includes health insurance risks.

- ***A Global Framework for Insurer Solvency Assessment*** (also referred to as the *Blue Book*). Written in 2004 by the Insurer Solvency Assessment Working Group of the IAA.

- **Guarantee**. An obligation that is not subject to an option of the obliged and does not specifically depend on the performance of the obliged.

- **Hedgeable risks**. A characteristic of an item that conceptually may be replicated by items traded in an active market.

- **Hedging**. A risk mitigation technique that involves holding a replicated item, regardless of whether an active market exists for that item. A perfect hedge is one in which an exactly comparable item is held, while a partial or incomplete hedge is one in which a comparable item is positively correlated, but is not exactly comparable.

- **IFRS 4**. International Financial Reporting Standard Number 4, "Insurance Contracts".

- **Insurance**. Accounting: A contract feature under which one party (the insurer) accepts significant risk from another party (the policyholder) by agreeing to compensate the policyholder if a specified uncertain future event (the insured event) adversely affects the policyholder. [IFRS 4, Appendix A]. The legal definition of insurance is subject to local law and regulation, but in all cases relates to the provision of insurance coverage.

- **IAA**. International Actuarial Association.

- **IASB**. International Accounting Standards Board.

- **IAIS**. International Association of Insurance Supervisors.

- **Liability** (the liability for an obligation for an insurance contract in some regulatory contexts is referred as a *technical provision* or *actuarial reserve)*. The amount recognized in the balance sheet of an entity that represents the net effect of the net obligations under an insurance contract. Accounting: "A present obligation of the enterprise arising from past events, the settlement of

which is expected to result in an outflow from the enterprise of resources embodying economic benefits." [IAS 37, Definitions]

- **Life insurance**. Insurance risk associated with the death or survival of an insured. It often is used to include annuities, and in some contexts also includes some forms of health insurance.

- **Liquidity**. A characteristic of an asset or liability regarding the ability of its owner or bearer to be converted to cash or cash equivalent when called upon

- **Loss adjustment expense** (for life and health insurance sometimes referred to as *claim settlement expense*). Expense of an insurer associated with the management or defense of its obligation with regard to claims made under an insurance contract.

- **Margin over current estimate** (*MOCE*, see *risk margin*). The risk margin that reflects the level of risk and uncertainty in the determination of the current estimate.

- **Market factor**. A specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating, credit index or other variable, provided that in the case of a non-financial variable the variable is not specific to a party to the contract. [taken from, but not defined in IFRS 4, Appendix A, in the definition of *financial risk*]

- **Measurement**. The process of determining or estimate a value, often a financial value.

- **Measurement date**. The date at which values are measured, in contrast with the date on which the calculations take place

- **Measurement input** (also referred to as *assumption*).

- **Non-market assumption**. An assumption that refers to items other than price available from a market, such as mortality rates in the case of life insurance contracts.

- **Normal distribution**. A probability distribution which is symmetric around its mean whose density takes the form of a bell-shaped curve with a single peak.

- **Obligation**. The duty associated with a contractual promise or arising from regulatory requirements. Accounting: "A duty or responsibility to act or perform in a certain way. Obligations may be legally enforceable as a consequence of a binding contract or statutory requirement. Obligations also arise, however,

from normal business practice, custom and a desire to maintain good business relations or act in an equitable manner." [IASB Framework, 60]

- **Offsetting risks.** A risk mitigation technique that uses the negative correlation of the uncertainty associated with a second set of obligations or rights to reduce the risk for a first set of obligations or rights.

- **Operational risk**. A risk of loss resulting from inadequate or failed internal processes, people or systems, or from external events affecting the operations of the entity directly, rather than directly related to contractual related risks.

- **Option**. A right under a contract to unilaterally select one of a defined set of rights or obligations subsequently available under the contract.

- **Parameter risk**. The risk of an estimation error in an underlying parameter in the measurement of a financial item.

- **Percentile method** (see *quantile method*).

- **Policyholder behavior**. Selection by a policyholder of an available option within a contract.

- **Policyholder bonus** (also referred to as *bonus* or *policyholder dividend*). The amount paid to a policyholder by an insurer relating to a participating (insurance or investment) contract in excess of what is contractually guaranteed.

- **Pooling**. A risk mitigation technique involving the grouping of insurance contracts with similar insurance risk exposures.

- **Portfolio**. A group of similar items managed in combination.

- **Probability density function** (*PDF*). The shape of the probability curve of a mathematical function of a continuous random variable. It is the first derivative of the *probability distribution function* (sometimes referred to as the *cumulative distribution function*] is the probability that a value is greater than a certain number.

- **Process risk** (also referred to as *deviation risk* or *statistical risk*). The risk of statistical fluctuation of an uncertain value due to a lack of size of what is being measured. It can be measured before or after risk mitigation techniques are applied.

- **Quantile method** (also referred to as the *confidence level method*). An approach used to estimate risk margins that expresses uncertainty in terms of

the excess of a percentile (quantile) for a given confidence level above the expected value for a given period, such as the lifetime of the coverage.

- **Reference entity**. A large, well diversified and financially secure entity that is used to identify a hypothetical entity to determine certain assumptions in a measurement approach. In certain applications, the entity is assumed to be fully diversified.

- **Regulatory capital** (see *capital*).

- **Reinsurance**. An insurance contract issued by one insurer (the reinsurer) to compensate another insurer if an insured event occurs. [IFRS 4, Appendix A]

- **Replication**. A method by which reliable prices can be assigned through equivalent means, such as through observation of market prices for one or more transactions that are equivalent to the value desired.

- **Risk**. The variability in outcomes in a process that is fully understood, e.g., the result of rolling a pair of fair dice. [IAA Blue Book]

- **Risk concentration**. The extent to which an entity is overly exposed to a particular risk or type of risk.

- **Risk diversification**. A risk mitigation technique involving diversifying the portfolio. A risk is diversifiable if it is of sufficient size and type for which there are sufficient uncorrelated but dissimilar risks available to reduce the fluctuations caused by the risk or type of risk in a diversified portfolio.

- **Risk margin** (also referred to as *margin over current estimate* or *margin*). The amount of a measurement of a liability associated with the risk and uncertainty associated with insurance risk. An amount or *margin* reflecting an assessment of the uncertainty inherent in an insurance risk with certain attributes based on a specific measurement approach.

- **Risk Margin Working Group** (*RMWG*). The Task Force of the IAA, initiated in 2005, to respond to a request of the IAIS.

- **Risk mitigation technique**. A management approach that reduces a risk born by the entity.

- **Service margin**. A margin included in the measurement of a liability for services not involving insurance risk, if market participants would be expected to require such a price for providing the service.

- **Skewness**. The extent to which a probability distribution deviates from that of a distribution which is symmetric in nature.

- **Stand ready obligation** (also referred to as an *unexpired risk liability*). The obligation to be prepared to deliver resources, e.g., a product or service in response to an event outside the control of the obliged.

- **Swap rate**. An interest rate swap contract is an agreement between two counterparties to exchange fixed interest-rate payments for floating interest rate payments, based on a pre-determined notional principal, at the start of each of a number of successive periods.

- **Swiss Solvency Test** (*SST*). Statutory test of the adequacy of the capital held by a Swiss insurer.

- **Tail of the liability**. The portion of the probability density function of the expected cost of the remaining contract risk exposure in excess of a specified high confidence level.

- **TailVar** (or TVaR, see *Conditional tail expectation*).

- **Technical provision** (see *liability*). An amount set aside on the balance sheet to meet liabilities arising out of insurance contracts, including claims provision (whether reported or not), provision for unearned premiums, provision for unexpired risks, life assurance provision and other liabilities related to life insurance contracts (e.g. premium deposits, savings accumulated over the term of with-profit policies). [IAIS, Glossary]

- **Total balance sheet** (also referred to as *total financial resource requirements*). The sum of the technical provisions and required capital of an entity resulting from a specified regulatory measurement approach.

- **Uncertainty**. The additional variability in outcomes that occurs because the process is not fully understand, the model used might be incorrect to some degree and/or the actual model parameters will vary from the estimated parameters. [IAA Blue Book]

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