



Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins

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An International Actuarial Research Paper
Prepared by the ad hoc Risk Margin Working Group

International Actuarial Association
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Table of Contents

1. Executive Summary	1
Current estimates: expected cash flows	1
Current estimates: discounting cash flows.....	2
Margin over current estimates: the risk margin	2
2. Objectives and Structure of this Paper	5
2.1 Objectives.....	5
2.2 Structure.....	6
3. Introduction to Measurement	7
3.1 Purposes of measurement	7
3.2 International standard setter developments	8
3.3 Total balance sheet approach	10
3.4 Basic concepts in measurement of values for financial reporting	11
3.4.1 Measurement objective	12
3.4.2 Components of cash flows	13
3.4.3 Mark-to-market or mark-to-model	13
3.4.4 Calibration	14
3.4.5 The context within which the estimation is made	14
3.4.6 Interrelation between the building blocks	15
3.4.7 Unit of measurement.....	16
3.4.8 Assumption basis	17
3.4.9 Reliability and auditability	18
4. Current Estimates	21
4.1 Introduction.....	21
4.2 All relevant cash flows included	22
4.3 Valuation technique (methodology) and considerations regarding its inputs	23
4.4 Market and non-market inputs.....	24
4.4.1 Market inputs.....	24
4.4.2 Non-market inputs	25
4.5 Assumptions / inputs – characteristics	27
4.5.1 Non-market-based assumptions – current conditions and expectations.....	27
4.5.2 Non-market-based assumptions – portfolio as the unit of account	28
4.5.3 Non-market-based assumptions – updating.....	29
4.5.4 Consistency of assumptions.....	30
4.5.5 Asymmetry of expected losses or benefits.....	31
4.6 Approximations.....	32
4.7 Quality of data and credibility approaches	34
5. Discounting Cash Flows	37
5.1 Introduction.....	37
5.2 Composition of interest rates.....	40

5.3	Risk-free discount rates.....	45
5.3.1	Government bond rates.....	46
5.3.2	Government bond rates plus adjustment	48
5.3.3	Corporate bond rates minus an adjustment	49
5.3.4	Swap rates minus adjustment	50
5.3.5	Comparison.....	54
5.4	Liquidity	55
5.4.1	The liquidity premium	55
5.4.2	Estimating the liquidity premium.....	58
5.5	Linked (and related) obligations	59
6.	Risk Margin Measurement Methods	63
6.1	The objectives of risk margins.....	63
6.1.1	The risk margin for “policyholder protection” as an element of prudence	64
6.1.2	The risk margin as a provision for the cost or price for bearing risk.....	65
6.1.3	The risk margin as a provision for the price for bearing risk – exit value approach	65
6.1.4	The risk margin as a provision for the cost of bearing risk.....	66
6.1.5	Relationship between the various risk margin perspectives.....	67
6.2	Desirable risk margin characteristics.....	69
6.3	Possible approaches to risk margins.....	71
6.3.1	Risk margin approaches – historical perspective	72
6.4	Statistical concepts.....	73
6.5	Approaches to quantifying risk margins – examples	75
6.5.1	Quantile approaches	76
6.5.2	Cost of capital method.....	79
6.5.3	Discount-related risk margins.....	84
6.5.4	Explicit assumptions.....	85
6.5.5	Qualitative comparison of risk methods – shape and time.....	86
6.6	Quantitative comparison of methods.....	89
6.7	Context for risk margin measurement—pooling, diversification and reference portfolio/entity concept	90
6.7.1	Pooling and diversification	90
6.7.2	Reference portfolio/entity concept.....	90
6.8	Context for risk measurement – risks to be considered	93
6.9	Context for risk margins – time horizon and risk perception	95
6.10	Practical issues and partial solutions	96
6.10.1	A possible simplified approach to reflect diversification and pooling – defining the reference entity.....	96
6.10.2	Calibration and consistency	96
6.10.3	Reliance on models.....	97
6.10.4	Sources of risk distributions/treatment of extreme events.....	98
6.10.5	Practical issues with quantile approaches	99
6.10.6	Determining the “cost” in the cost of capital method	100
6.10.7	Capital in the cost of capital method	101
6.10.8	Definition of solvency for capital modelling in the cost of capital method.....	102
6.11	A qualitative comparison of various risk margin methods	102
6.11.1	Compliance with the five IAIS characteristics.....	103
6.11.2	Compliance with RMWG desirable characteristics 1-3	105
6.11.3	Consistency among classes of business – RMWG desirable characteristic 4..	106
6.11.4	Ease of calculation – RMWG desirable characteristic 5.....	107

6.11.5	RMWG desirable characteristics 6 - 8.....	109
6.11.6	Market-consistency	109
6.11.7	Summary.....	110
7.	Risk Mitigation Techniques	113
7.1	Introduction.....	113
7.2	Pooling	114
7.3	Risk diversification.....	115
7.4	Offsetting risks.....	117
7.5	Reinsurance	118
7.6	Contractual features related to assets and asset management	120
7.7	Contract adaptability features.....	121
7.8	Discretionary benefits.....	123
7.9	Risk concentration.....	126
8.	Other Issues.....	127
8.1	Service margins.....	127
8.2	Margins under a “no profit at issue” constraint	129
8.3	Credit characteristics of the liability	130
8.4	Operational risk	134
8.5	Governance.....	134
Appendix A –	The IAA ad hoc Risk Margin Working Group Background	135
A1	Background	135
A2	Terms of Reference.....	136
A2.1	Scope and objectives	136
A2.2	IAA input requested.....	137
A3	Process followed	137
A4	Note regarding terminology	138
Appendix B –	Current Estimate Assumptions	139
B1	Mortality rates.....	139
B1.1	The level.....	139
B1.2	The trend.....	142
B1.3	An example of determination of the current estimate for mortality incorporating historical information about level and trend	145
B2	Property and casualty (general) insurance claim development	146
B2.1	Case liabilities, incurred but not reported (IBNR) liabilities, and incurred but not enough reported (IBNER) liabilities	146
B2.2	Loss adjustment expense (LAE)	147
B2.3	Exposure to risk, frequency and severity	148
B2.4	Pertinent experience data	149
B2.5	Methodologies.....	150
B3	Stand ready obligation for property and casualty and other short-period contract periods.....	151
B4	Expenses (other than loss adjustment expenses).....	152
B5	Policyholder behaviour	156
B5.1	Extent of rational behaviour.....	156
B5.2	Discontinuance rates.....	157
B5.3	Other optionalities	158

B6	Other assumptions	160
B6.1	Insurer behaviour	160
B6.2	Reinsurance considerations	161
B6.3	Other assumptions	162
Appendix C – Statistical Background, Product Assumptions and Risk Distributions		
	Considered for Risk Margins for Different Time Horizons	163
C1	Coverage and risk distributions	163
C2	Conditional Tail Expectation	166
C3	Minimum capital requirements and cost of capital formulas	167
	Test A - consistent with the Swiss Solvency Test	167
	Test B – sometimes called the capital cash flow calculation (CCF)	168
C4	Lognormal distribution and the normal power approximation	170
C5	Risk distributions considered for risk margins - time horizon and changes in risk perception	171
	Runoff test	171
	Change in Capital Test	171
	Comments	172
	Distributions used in the examples in this paper	174
Appendix D – Life Insurance and Annuity Risk Margin Examples		
D1	Example – Risk margins for a single premium payout annuity contract (guaranteed for the whole life)	175
D2	Example – Risk margins for a term life insurance contract	180
D3	Models used	183
D3.1	Mortality assumption	183
D3.2	Calculating economic capital using a Student's t Distribution	184
D3.3	When insufficient volume of data is available	185
D3.4	Mortality level uncertainty	185
D4	Other items	187
Appendix E – Diversification		
E1	Some general theory and thoughts	189
E2	Technical approaches	190
E3	Marginal diversification	190
Appendix F – Research Recommendations		
	General measurement and data	195
	Extreme events (Sections 4, 5 and 6)	195
	Discount rates (Section 5)	195
	Risk margins methodologies (Section 6 and 7)	195
	Diversification	196
	Other items	196
Tables and Charts		
		197
Glossary		
		199
Bibliography		
		207

1. Executive Summary

The ad hoc Risk Margin Working Group (RMWG) of the International Actuarial Association (IAA) has conducted research into the measurement of liabilities for insurance contracts that has resulted in this paper. The issues addressed are those that will help determine future practice for measuring liabilities for insurance contracts for both regulatory and general purpose financial reporting. It focuses on current estimates and risk margins, which the RMWG believes to be an appropriate basis for the measurement of liabilities for insurance contracts. During the course of this research the RMWG has sought and incorporated input from various stakeholders in the measurement of these liabilities.

Current estimates: expected cash flows

Current estimates are the unbiased probability-weighted expected (mean) values of relevant cash flows, discounted for the time value of money. Current estimates comprise the bulk of insurance contract liabilities and 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 outcomes.

Historical or current experience data from the portfolio of contracts or claims being measured is often the best source from which current expectations are derived. However, this 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 using probability distributions in all situations. In any case, however, a range of probabilities would be considered. In addition, current estimates need to be consistent with the scope and objective of the purpose for which the estimates are being made.

Measurement inputs can either be market- or non-market-based. For insurance contracts, the RMWG expects a model would be used for most inputs, based upon available, relevant and reliable portfolio-specific information. When portfolio-specific data is not available, data from similar risks, such as from industry experience, would be appropriately adjusted to reflect the characteristics of the portfolio.

Some accounting standard setters believe that market-consistent assumptions are the most reliable and objective measurement inputs. Nevertheless, for the large majority of contracts offered by insurers, market-based inputs (assumptions) for non-financial risks are either not available or are available only for certain measurement assumptions. For the measurement of liabilities for insurance contracts, the use of market-based inputs is usually restricted to financial assumptions, where relevant and reliable information is often available.

As this paper primarily deals with non-hedgeable risks for which market inputs based on relevant and reliable observable prices are not currently available, the RMWG agrees that it is currently not possible to determine whether a method is “market-consistent in practice”.

However, it is useful to consider the extent to which a methodology is “market-consistent in theory”.

The applicable standard under which the measurement is being prepared may determine whether assumptions used are market-based or non-market-based. The effective implementation of financial reporting standards regarding the measurement of liabilities of insurance contracts may need to include overall guidance about the selection of inputs and examples of calibration sources for “market-consistency” purposes. In any case, selections and evaluations of the appropriateness of assumptions are expected to require actuarial evaluation and judgment.

Considerations for developing expected cash flows are discussed in Section 4 and specific inputs are discussed in Appendix B.

Current estimates: discounting cash flows

The objective of applying a discount rate to a future cash flow is to reflect the time value of money. The question of how to select the discount rate for this purpose does not have an easy answer and often depends upon the applicable financial reporting requirements and objectives, and the timing of the cash flow. A discussion of candidates for the discount rate and their sources, as well as adjustments to the discount that may be needed is in Section 5. A commonly used candidate is a (default) risk-free interest rate, although in some cases the effect of liquidity is reflected.

A significant consideration when selecting a discount rate is whether it is consistent with the assumptions underlying the estimate of the expected cash flows under the contracts. For example, when a contract’s obligations are directly linked to the performance of specified assets, discount rates that are consistent with the expected investment earnings on the designated portfolio of assets may be appropriate. When a non-risk free rate is used for the purpose of determining a present value, appropriate financial risk margins need to be reflected in its measurement. If the risk margin used is based on the expected cash flows, care is needed to avoid double-counting of the provision for risk.

Margin over current estimates: the risk margin

Using a market-consistent methodology, transaction prices can be expressed in terms of sum of the current estimate and the risk margin. The current estimate relates to the expected cash flows, whereas the risk margin includes an allowance for risk that is inevitably included in a transaction price. The risk margin in an efficient market is equal to the estimated market price minus the present value of expected cash flows. In the absence of a deep and liquid secondary market for insurance contract liabilities, however, the risk margin would be derived through modeling. To maintain consistency between current estimates and the risk margin, the risk margin would be based on assumptions and approaches that a market participant would use and would be sensitive to changes in the market to the extent observable, that is, market-based.

The objective of the risk margin can be viewed from different perspectives. It can be seen (1) as the reward for risk bearing, measured in terms of the inherent uncertainty in the estimation of

insurance liabilities and in the future financial return from the contract or (2) 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 similar measurement outcomes.

The IAA, the International Association of Insurance Supervisors¹ (IAIS), and the International Accounting Standards Board² (IASB) have indicated that there are five key desirable characteristics of risk margins:

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.

This paper expands upon these risk margin characteristics by introducing more detailed calculation requirements, such as the application of a consistent methodology for the entire lifetime of the contract, being consistent with the determination of current estimates, being consistent with sound insurance pricing, varying the margin by product based on risk differences between products, and considering the ease of calculation.

In addition, as indicated in Section 7, the RMWG believes that the amount of the risk margin should reflect the expected effect of the risk mitigation approaches used. These approaches include combining of cash flows, including pooling of risks, diversification and off-setting, reinsurance, product adaptability and discretionary features and asset liability management techniques.

Approaches for determining risk margins have been grouped into the following four families of approaches that meet the IASB's current view³ to have an "explicit" risk margin:

1. *Quantile methods* use percentile/confidence levels (VaR) 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.

¹ IAIS *Second Liabilities Paper* (2006), paragraph 59

² IASB *Discussion Paper Preliminary Views on Insurance Contracts* (2007), Part 2 Appendix F4

³ IASB *Discussion Paper* (2007), Part 1 paragraph 90

3. *Discount related methods* discount future expected cash flows using the risk-free interest rate minus a selected risk adjustment.
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.

While no method can currently be tested for market-consistency for insurance risks (given that there is no current market for insurance liabilities), we have evaluated each of these four main risk margin approaches and arrived at the following conclusions:

- 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.
- Within the quantile family of methods, CTE approaches are conceptually more sound than confidence level approaches, with the differences being significant for products with more skewed risk distributions. To the extent that confidence levels are specified for risk margins or capital measurement in the cost of capital method, these can better represent appropriate capital levels for this purpose. Regulatory oversight or actuarial practice would apply higher levels for products whose risk distributions are more highly skewed.
- Explicit assumptions and discount approaches could be used as approximations for other methods. However, consistency among insurance products and between insurance and other industries is not practical using a purely explicit assumption or discount approach.

The RMWG believes that this research paper addresses important topics and issues in the context of the measurement of the liabilities for insurance contracts. While the RMWG believes the paper will fulfill the objectives as stated, it is also clear that further work needs to be done on several of the issues identified, as summarized in Appendix F. As a result, the RMWG suggests the establishment of further IAA working parties to address these issues.

2. Objectives and Structure of this Paper

2.1 Objectives

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 the Insurance Contracts Subcommittee of the International Association of Insurance Supervisors (IAIS).

In the course of the development of this paper, the RMWG also considered relevant issues associated with the simultaneous development of an updated standard for general purpose financial reporting being considered by the International Accounting Standards Board (IASB). Although this paper is not intended to provide comments on the IASB's currently expressed views, it does at least partly reflect the development of those proposals to the date of this paper and of other inputs to the IASB due process. At the time of publication of this paper this process has not reached firm conclusions on many key issues; as such it does not necessarily address all matters relevant to these 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 actuarial guidance.

The objectives of this paper focus on information that the RMWG hopes will prove useful for both regulatory and general purpose financial reporting in assessing the basis of actuarially sound methodologies and assumptions that might be used to measure:

- current estimates⁴ (without risk margins) incorporated in the measurement of the liabilities of insurance contracts (in some jurisdictions these liabilities are referred to as “technical provisions” or “actuarial reserves”); and
- risk margins appropriate for the measurement of the liabilities for insurance contracts.

This paper emphasizes principles useful for such purposes. Although, for illustrative purposes, 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 does it address all of the wide variety of current types of contracts offered in the insurance marketplaces around the world. As a result, it is not intended to provide a comprehensive survey or identify the single best practice, in part because different circumstances, types of contracts and types of insurance claims may dictate that liabilities are best measured by different actuarial techniques. In many cases, more than one method may be acceptable, depending on the applicable financial reporting standards and circumstances.

⁴ See the Glossary and Appendix A4 for a discussion of key terminology used in this paper.

2.2 Structure

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

- The background leading to the formation of the RMWG is described in Appendix A1, its Terms of Reference are given in Appendix A2 and the process it followed in the development of this paper is outlined in Appendix A3.
- 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 discount rates and risk margins considered in Sections 5 and 6, respectively. Specific assumptions/inputs are discussed in Appendix B. A discussion of probability distributions used in this paper is given in Appendix C.
- Possible bases for discounting and applicable considerations are discussed in Section 5.
- A discussion of the objectives and methodologies that can be used in estimating risk margins is given in Section 6, with additional examples of application to life and annuity contracts in Appendix D.
- The effect and treatment of common mitigation techniques associated with insurance contracts on risk margins are primarily discussed in Section 7. A further discussion of some of the techniques is also included in Section 6 and Appendix E.
- 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.
- Related issues for which further research efforts would benefit the development of the topics addressed in this paper are listed in Appendix F.

3. Introduction to Measurement

3.1 Purposes of measurement

One of the most significant actuarial activities involving insurance is the measurement and valuation of the expected cash flows of insurance and related contracts. Applications 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 and risk management;
- analyzing mergers and acquisitions; and
- developing performance metrics and internal management reports.

Although the bases for values used for these purposes have varied by application and jurisdiction, some fundamental principles are common to all. In addition, the assumptions underlying them can differ, in some cases significantly, depending on the context and requirements that apply.

As described in Section 2, this paper is focused on values used for financial reporting and regulatory purposes. Even in these limited areas, a wide range of principles and rules have historically been applied. Measures developed for solvency related purposes may or may not generate values different from 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”. With respect to these estimates,

1. the liabilities referred to might be assets, for example, when they are associated with ceded reinsurance business rather than with directly written or assumed reinsurance business, in which case the measurement is from the view of the purchaser of insurance;
2. such estimates have been given different labels in different contexts and different jurisdictions, for example, the IAIS has often referred to them as “technical provisions”, while in certain jurisdictions they have also been referred to as “actuarial reserves” or “contingent liabilities”; and

3. accounting and regulatory frameworks or rules may require or suggest the methods and types of assumptions to be used.

A significant part of the uncertainty or risks associated with the rights and obligations under the contracts within the scope of this paper may be reflected in the assessment of required or desired levels of capital, rather than in liabilities. In an analysis of the financial condition of an insurer, the measurement of the aggregate of the assets and liabilities of contracts and all of their associated risks has been referred to as a “total balance sheet approach”. Note that a discussion of 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 all of the methods and types of assumptions currently used for all of these measures. Focus is instead placed on a discussion of the measurement approaches that are currently in common use and those that are expected to be used in future international accounting and regulatory contexts.

3.2 International standard setter developments

Important discussions regarding the development of a revised framework for financial reporting of insurance contracts are currently underway for both general purpose accounting and regulatory purposes. As part of that process, the IASB exposed for comment in 2007 its Discussion Paper *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 to observe these values for insurance contracts, 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.

Subsequent discussion in the IASB's Insurance Working Group has identified a fulfillment value approach. This is based on the amount that would be required to settle the insurer's liabilities (i.e., to fulfill its contractual obligations) in the normal course of business.

It is expected that some of the concepts underlying the discussion involved in Phase 2 of the IASB's Insurance Contracts project at the time this paper was written will continue to evolve in the near future as the IASB moves toward the exposure draft and adoption stages of their project.

There are separate, but not completely independent, developments undertaken by the IAIS, as well as by local and regional supervisors. *The IAIS Common Structure for the Assessment of Insurer Solvency* (2007) adopted principles similar to what the IASB is discussing. Although the IAIS in its *Second Liabilities Paper* (2006) expressed the desire to use what the IASB adopts for measurement of insurance contract liabilities as the basis for regulatory reporting, the extent to which the two organizations will end up using the same methodology is not yet certain.

This contrasts with common current practice. In many jurisdictions, historical regulatory emphasis in the measurement of liabilities for insurance contracts has been placed on the protection of the insurers' policyholders. Often guidance has 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 has been particularly

true in jurisdictions where current regulatory capital requirements were introduced prior to the introduction of more risk-based capital requirements elsewhere.

The current trend in both areas is to enhance and converge reporting to the extent possible through financial statements that are consistent, transparent and representative of the insurer's actual performance, while still achieving the rather different objectives of the general purpose and regulatory financial reporting systems.

According to the IASB's current *Framework for the Preparation and Presentation of Financial Reports* (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." Unless reliable and relevant prices for the obligations can be observed, a liability is a prospective measure of the value 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 present value of the cash flows associated with the obligations generated by a portfolio of insurance contracts⁵ and a margin for risk.

As the international body that provides support for insurance supervision, the IAIS is concerned with both general purpose accounting and with solvency issues. The IAIS has expressed the following view.

... (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.⁶

This view was expanded upon, as follows.

There is widespread support for an effort to achieve a single set of accounts that could be utilised for both general purpose financial reporting 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. ... 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.⁷

⁵ The portfolio may include insurance contracts no longer in force, in the case of unsettled claims.

⁶ IAIS *Second Liabilities Paper* (2006), Executive Summary

⁷ IAIS *Second Liabilities Paper* (2006), Introduction

3.3 Total balance sheet approach

As discussed in “A Global Framework for Insurer Solvency Assessment” (2004, often called the *Blue Book*), a research report written by the IAA's Insurer Solvency Assessment Working Party, an entity's risks are properly assessed by applying a total balance sheet approach, regardless of whether the insurer's risks are reflected in the value of the insurer's liabilities for regulatory purposes or only in the determination of its minimum required capital.

While risk margins in liabilities and capital both provide for risks inherent in insurance contracts and for other risks undertaken by an insurer, they do not serve the same objective. Capital is needed to ensure that an entity has sufficient financial resources to withstand a significant adverse experience deviation and still be able to satisfy its obligations to its policyholders. Hence, capital should provide a high level of financial assurance that obligations to current and future policyholders will be met by the insurer.

In contrast, the risk margins discussed in this paper generally provide a lower level of confidence regarding this ability but are not necessarily based on a confidence level approach. Alternatives include an economic value of risk and uncertainty, the price at which willing parties would transfer the obligation in an efficient market or the cost associated with the need to hold capital in excess of the current estimate. See Section 6.1 for a more complete discussion of this distinction and these viewpoints.

In addition, a proper allocation of risks between liabilities and capital can enable liabilities, together with a set of consistently valued assets, to provide a realistic measurement of performance, as well as 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's Accounting Committee encourages the convergence of standards and practice among jurisdictions, as well as between general purpose and regulatory financial reporting.

Although a detailed discussion of solvency issues is outside the scope of this paper, the context of the total balance sheet in which the obligations reside and the inter-relations between the treatment of risk within liabilities and capital is discussed in this paper where appropriate. Nevertheless, a discussion of liability measurement used in solvency assessment is a major topic discussed here.

A key proposition held 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 changes in those assets. This financial reporting principle is generally applied in this paper through use of a replicating portfolio concept for the measurement of hedgeable risks for insurance contracts, with asset credit risk and market risk factors reflected outside of the measurement of liabilities.

It has been suggested that, if reflected in liabilities, hedgeable credit risk and market risk would be treated differently from those that are not hedgeable. All such risks should be addressed in a regulatory solvency regime through “total balance sheet resources”.

3.4 Basic concepts in measurement of values for financial reporting

The objective of a financial statement is to provide useful information to its users. The principle types of financial reporting and their primary users are:

- insurance (solvency) regulators
- general purpose – although primarily current and prospective investors, others, such as creditors, also use them; proposed changes to the IASB's current *Framework* would formally embrace some or all of this wider group
- tax – for income tax purposes the applicable taxing authorities – usually dictated by a set of rules set forth by the taxing authority
- management – internally reported values can be consistent with those developed from external reporting rules or can be designed to satisfy decision-making needs as determined by management.

This paper focuses on liabilities whose values are designed for the first two purposes.

A liability, according to the IASB's current *Framework*, is "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". Accordingly, it corresponds to an obligation that exists according to a contract that has been written. Before measurement is considered, it has to be determined whether it is appropriate under the applicable accounting system for the liability to be recognized, that is, whether it qualifies to be considered as a liability. Recognition (or de-recognition) issues are outside the scope of this paper.

A liability for an insurance contract (determined according with regulatory reporting rules or with accounting standards for general purpose reporting) can in some cases take on a negative value, resulting in an asset or a contra-liability. Some financial reporting systems do not permit an insurer to record an asset for this purpose in its balance sheet, although the amount of the otherwise calculated negative value might be required to be disclosed separately.

Most liabilities in financial statements involve some degree of uncertainty and, as a result, their measurement is represented by estimates. In particular, liabilities for insurance contracts reflect expected cash flows, rather than the actual cash flows.

This uncertainty is a result of the stochastic nature of several of the key processes involved, and the risk that the expected value and the potential distribution of these processes are misestimated. The stochastic processes include those involving policyholder behaviour that may affect the timing of future premium payments and the termination of the contract, the incidence and severity of the contingent events insured, and claim developments once a contingent event occurs. In addition, some of these processes may not be independent of each other. The value of the liability for the entire contract is based on the net effect of these processes. To reflect these individual and consolidated processes, the liability of an insurance contract is usually valued at an amount greater than its expected value.

In measuring the liabilities of insurance contracts 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 entity's accounting policy.

Relevant disclosure is needed to provide additional useful information to the users of the financial statement in relation to the entity and the values included in the statement. This can take many forms, but in any case should be clear, concise, not at too aggregate or too detailed a level, and in segments consistent with either the way that the business or the risks involved are managed. Disclosure provides useful information about the methods and assumptions used, the uncertainties associated with the estimates and, where practical, the effect of sensitivities or alternative scenarios on the liabilities.

Values of liabilities according to most financial reporting systems reflect current estimates of the net value of the obligations and rights under a set of contracts. These estimates are made as of the report date (the “when”), and reflect the expected value, timing and uncertainty associated with the cash flows of a set of contracts (the “how”), but not explicitly the “what”. The following subsections further explore the how and what of these estimates.

3.4.1 Measurement objective

If practical, it is desirable to set forth the overall measurement objective (attribute) in principle-based terms although, depending on the application, the method can be spelled out in a series of rules or a combination of rules and principles. For financial reporting purposes, several possible objectives could be applied, including the following.

- Historical cost reflects a past price or inputs that reflect original assumptions.
- Exit value represents the amount that another party (i.e., a market participant) would agree to pay to transfer the financial item or group of contracts.
- In the IASB context, settlement value is the amount that would be needed to immediately settle the obligation.
- Fulfillment value is a measure of the amount to complete the obligation as it becomes due, on the basis of the cash flows associated with the settlement of the obligations over the course of their lifetime as they come due.

In principle, the last three of these possible objectives are wholly based on current assumptions; in other words, they only use past conditions as a basis for assessing what future conditions are expected to be rather than using them without reassessment. Historically, regulatory or accounting standards, however, have sometimes required certain assumptions to be locked in at outset of a contract.

It is outside the scope of this paper to discuss the relative desirability of any specific measurement objective. Nevertheless, since an historical cost model is not consistent with the measurement of a current set of rights and obligations, this paper does not address estimates made on that basis and focuses on attributes with neutral values based on current expectations concerning the rights and obligations of insurance contracts.

3.4.2 Components of cash flows

In some cases, the cash flows are split into component parts. This is often done for computational convenience, to satisfy financial reporting requirements, or to provide more insightful information. The practicality of such bifurcation or unbundling of components depends in part on whether, or the extent to which, they are inter-related. If inter-related, the order that they are measured might affect their combined value or the allocation of the amount of the total liability into component parts. These components can be categorized as relating to insurance, financial and service. Although such a split might facilitate comparability across type of contracts or entities, the financial reporting requirement involved and its cost, practicality and usefulness are considered in determining whether or how to do this. This is particularly important if the accounting standards differ between the components.

3.4.3 Mark-to-market or mark-to-model

In general, there are two approaches that can be taken to estimate the liability of an insurance contract, based on:

1. observable prices for transactions for the contract (or for components or elements of the contract) referred to as a mark-to-market approach; and
2. a model, a representation of the value based on a potentially wide variety of sources, referred to as a mark-to-model approach.

One or more inputs to the second approach can also be determined from observable prices from relevant transactions or from information available in the market (e.g., interest rates).

An important difference between the two approaches is that transaction prices usually incorporate an implicit market-based assessment of the risks involved (and expected profit, if any) that may be the result of a price negotiation process, while a mark-to-model basis has to explicitly include such a provision. Since any transaction price will also implicitly incorporate the effect of the time value of money, any non-price basis also would incorporate such a provision, although practice can vary. Several accounting systems do not reflect estimates of these matters in liability values.

The reliability of observable prices and inputs is a function of the reliability of the market in which they are observed; that is, factors including the amount of activity and liquidity available in the market. The relevance of observable prices and inputs depends on the similarity of the market and the contract to those whose prices or inputs can be observed. In most cases, there is no reliable transfer market for insurance contracts, but pertinent information from relevant markets (e.g., interest rates) can and should be used in the measurement of their liabilities.

The components of a mark-to-model approach can be developed in a building block approach, similar to that advocated in IASB (2007). Although it is outside the scope of this paper to comment on the specifics of that measurement approach, several items relevant to the Discussion Paper will be addressed in this paper.

3.4.4 Calibration

Calibration refers to the process of setting inputs and assumptions relevant to the particular contract. The methods used to calibrate the liability, its components and its assumptions vary, depending on whether the approach is mark-to-market or mark-to-model. In a mark-to-market measurement (assuming that transactions or inputs in the market are relevant and reliable), calibration is with respect to observed prices in the market.

Approaches to calibration in a mark-to-model value or input can be made in one of several ways, all relating to the basis of the obligations or assumption, sometimes based on corresponding historical or similar values, with adjustments to make them relevant to the applicable future.

3.4.5 The context within which the estimation is made

The reported value of liabilities or assets may be affected by requirements under a 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 the appropriate unit of measurement. Certain financial reporting standards require market-based inputs, when they are relevant and reliable for use in the calculation of a liability, or observed market inputs (see Section 4.3). Another set of accounting standards may require certain inputs to be based on entity-specific or even regulatory assigned values.

In addition, prior to developing a current estimate, the object or scope of the estimation process needs to be fully defined or confirmed, that is, *what* is being recognized and then measured. The measurement typically includes all expected cash flows that relate to the recognized item. However, financial reporting requirements may define a different categorization, for example the separate recognition of associated income taxes.

If the obligation is directly affected by a specified set of assets, those assets could affect the current estimate of future cash flows or the risk margin in certain financial reporting structures.

In certain cases, financial or regulatory reporting standards or guidance may determine which cash flows can be included in the measurement of the liabilities for an insurance contract. These standards or guidance 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.

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

- The liability may not incorporate the effect of 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. Examples include internally generated goodwill, certain future renewal premiums that are not required to be paid under the contracts and cash flows after voluntary annuitization.

- 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, a current measurement would consider the most recent available information and expectations.
- A limitation of profits recognized at the outset of a contract might be introduced by modifying the expected cash flows included to require that the insurer not recognize profit at the time of issue (see Section 8.2).
- The measurement objective under which the estimate is made might be based on the expected fulfillment of the obligation, its transfer value or its “fair value”, although in practice there may sometimes be little practical difference between these amounts.
- Some accounting frameworks require market-consistent values and inputs to be used to the extent possible. Only where these are not available would entity-based measures or views be applied.
- Use of alternative discounting approaches. 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 in certain instances, although actuarial principles indicate that the time value of money should be reflected wherever it has a significant effect.
- Unless a financial reporting standard requires a deviation from a current estimate, there is no need for a liability adequacy test (LAT). If such methods or assumptions are used in measuring a current estimate-based liability, there may be a need for a LAT to ensure that the value adopted is not less than a current estimate or a current estimate plus a risk margin, as applicable.
- A cash value floor or prohibition of negative liabilities might be imposed that may affect the cash flows to be included in measurement.
- 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. In most accounting systems, the effect of events such as proposed legislative and regulatory changes after the measurement data are not reflected in the assumptions used in the measurement of liabilities. Nevertheless, if their impact was expected to be material, this effect would usually be disclosed.

3.4.6 Interrelation between the building blocks

In most of this paper, it is assumed that the basic components (estimated cash flows, discounting and risk margins) of measurement of the liabilities of insurance contracts are independent of each other. Nevertheless, in some respects, the three components are interrelated. A few examples follow.

- In traditional actuarial valuations of cash flows based on deterministic discounting, it makes no difference in which order discounting and estimated cash flows are determined. However, when introducing stochastic discounting, there is a difference.

- If cash flows are directly affected by what occurs in a market, for example, if lapse rates are related to market conditions, the expected cash flows and discount factors are interdependent. In this case it is the expected discounted cash flows that are calculated rather than the discounted expected cash flows, thereby directly linking these building blocks. To derive a valuation on a market-consistent basis, the expectation with respect a market-consistent measure is made or the discount factor is replaced by a market-consistent deflator.
- The risk margin is dependent on the level of the expected cash flows, as well as their uncertainty.
- The obligation may be expressed in terms of the performance of a specified set of assets.

A principle of current measurement is that a consistent set of assumptions is used, to the extent practical, in the selection of the estimated amounts and timings of a set of cash flows, cash flow scenarios, probabilities of cash flows and scenarios, discount rates and risk margins. To the extent that the total risk margin incorporated in an estimate of a liability includes both an insurance and financial risk margin (the latter relating to the uncertainty in the sovereign, credit and liquidity risks incorporated in the discount rate), it is important to avoid double-counting the risk margin. The discount rate reflects the general characteristics of the cash flows. This consistency should, to the extent practical and subject to the accounting convention used, also extend to the measurement approach applied to any corresponding assets.

In many cases assumptions within a component are inter-related. For example, the following pairs of experience assumptions may be inter-related:

- mortality and contract persistency;
- claim incidence and size; and
- loss adjustment expense and losses.

These interrelationships and their correlation should be considered in the measurement of the liability.

3.4.7 Unit of measurement

The essence of insurance is the aggregation of homogeneous risks, a transfer of risk from one party, often an individual, to another, often a large pool of similar risks. The pooling of risks allows the insurer to manage these risks through the use of the law of large numbers.

Each insurer may have a different objective or take a different approach to spreading its risks, through their strategic marketing and underwriting (selection) approach used and resulting insured mix. 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 often be made in more than one way. IFRS 4.18 indicates that a portfolio is an aggregation of contracts subject to broadly similar risks that are managed together; thus it could be a business unit or line of business, possibly consistent with segments used in segment reporting.

Although a mono-line insurer might include its entire business as a single portfolio, in most entities, relevant portfolios would be subsets of the business. Even in the mono-line case, different portfolios may exist, reflecting such factors as marketing channels or types of insured.

It is not only the type of insurance exposures that might be used in selecting appropriate portfolios. For example, private passenger automobile and commercial auto contracts can constitute separate portfolios; while they are subject to the same types of claim risk, the policyholders are quite different in nature. In this case, the method of management of the contracts can also be among the important factors to consider.

Given the nature of insurance, it is usually necessary to consider the portfolio of relatively homogeneous 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 Section 7 for a description of some of these techniques) it is often possible to combine portfolios of an insurer.

3.4.8 Assumption basis

The assumptions used can, in principle, be portfolio-specific, entity-specific or market-based. Portfolio-specific assumptions take into account the characteristics of the portfolio and are not affected by features of the entity that holds them, that is, they are the same no matter what entity is obligated to fulfill them. Entity-specific assumptions take into account features of the entity. Market-based assumptions are derived from observable market behaviour, mostly market prices.

The use of a portfolio-specific measure (even if the entity consists of multiple non-homogeneous portfolios) is usually more relevant to a contract than an entity-specific measure. The primary reason for this preference is that most insurers have multiple portfolios, each of which consists of different insurance risks. Another is that the characteristics of a portfolio can be strongly influenced by its history, particularly its underwriting and, for outstanding claims, their claim management history. A portfolio's characteristics can include the relevant risk characteristics of the portfolio and the business model used to obtain and manage the portfolio. The use of an overly small portfolio may be inappropriate. For example, a very small portfolio can include huge variations in experience that may overwhelm the real level and trend of the underlying experience.

Nevertheless, certain practical issues can cause a portfolio's value to vary, depending on the entity that holds it. In particular, one of these issues might be the operating expense assumptions. Due to the uniqueness of most insurance portfolios and differences between insurer strategies, efficiency of management methods and administrative systems, portfolio-specific, entity-specific and market-consistent values are often similar, if not identical.

The size of a portfolio can affect the extent that potential economies of scale are reflected in the expense assumption, in part by avoiding an allocation of fixed expenses to individual contracts that may be appropriate if no other contracts are considered (i.e., by not reflecting economies of scale on expense levels included in the measurement of the liability). The use of a contract as the unit of measurement would be inappropriate, as the market expects the use of expense aggregation and of economies of scale consistent with the type of contract involved. This is further discussed in Section 4.

If the financial reporting standard under which the current estimates are developed recognizes a hypothetical portfolio of relevant market participants, significant economies of scale can be reflected, possibly larger than those of the actual portfolio being evaluated.

3.4.9 Reliability and auditability

In addition to other desirable measurement objectives, it is important that the resulting liability measurement be reliable and auditable. This is in order that others who review the estimates made (be they internal management, peer reviewers, insurance supervisors, or experts used in the audit process) can verify the basis of the current estimates and to agree on the reasonableness of the estimates.

This is often evidenced by an appropriate control environment, audit trail and proper documentation of the basis and processes used in deriving the measurements. This applies to each of the measurement components and their assumptions. All pertinent information regarding the expected cash flows and their uncertainty should at least be considered, if not applied explicitly in the measurement calculations. That is, the measurement should be complete. Unless constrained by the financial reporting framework, all contractual features, risks, rights and obligations would be considered.

Although it is desirable that measurement be based totally on conceptually correct and precise calculations or measurements, practicality is also a consideration. The cost of deriving the liability measurement and the desired or acceptable level of accuracy involved can dictate practical approximations and the use of surrogates, reflecting the differences in cost involved and differences between the alternative values. In those cases, approximations may be applied. Note that the actuary using such an approximation needs to be prepared to provide the rationale and justification for using the approximation.

In addition, depending on the extent of desired or required levels of materiality, the methods and assumptions/inputs used are determined in an explicit and objective manner, capable of being communicated in a transparent manner. This is facilitated by having experts involved, often qualified actuaries. Appropriate education, experience and standards are needed to increase the trust and credibility in this process.

In the case of the use of models, reproducibility of results is important, as is the avoidance of “black box” models. Proper governance of the use of and oversight of models is required (see Section 8.5 for further discussion of governance issues associated with models and estimates). This is necessary in part to avoid the use of inappropriate subjectivity, and the potential for improper manipulation or fraud, as well as to increase their reliability and auditability.

Another element to consider is inadequate measurement resources. Often, where the actuarial profession is not sufficiently developed or is emerging, insurance contracts sold are less sophisticated and refined or sophisticated techniques may not be needed. In these cases, approximations or surrogate methods may be acceptable. In such cases knowledge sharing/transfer is needed, using relatively inexpensive technological approaches or educational and professional development programs and material. Even though simplified approaches may be necessary, this should not be an excuse for producing biased or misleading estimates. In some cases, the risk margin needs to be larger, as reliable and pertinent data may be sparse or not available at all.

Although principles should be universally applicable, possible proxies, standard formulas or rules of thumb might be able to be developed for less sophisticated markets (and possibly in small companies, for simplified contracts, or in less sophisticated markets in more advanced countries). Although it is unlikely that specific considerations are needed for such situations, a resolution of this problem is outside the scope of this paper but needs to be addressed by the actuarial profession as a whole, and not just in the jurisdiction affected. Note that this issue also affects the insurance industry and accounting/auditing profession in these situations. Lack of resources is no excuse for sloppiness or inadequate financial conditions. In any event, disclosure of the methods and procedures followed is necessary.

4. Current Estimates

4.1 Introduction

The objective of this section is to discuss factors that may be applicable to the development of *current estimates* as part of the measurement of liabilities of insurance contracts⁸. Current estimates have sometimes been referred to as “best estimates”⁹, 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. It is the mean value that is discussed in this paper, as it is the measure that most faithfully represents the current assessment of the relevant cash flows.

Both the IAIS¹⁰ and the IASB¹¹ have referred to the mean or expected value as “probability-weighted”. Although in some cases it may be practical to develop a probability distribution analytically based on theory or experience data to derive the mean value, in other cases other approaches to arrive at the expected value can be used. A more detailed discussion of alternative approaches is in Section 4.6.

In this paper, a current estimate does not include the margin for risk included in liabilities for insurance contracts that is discussed in Section 6. This contrasts with some uses of the term best estimate, such as in IAS 37, where measurement includes a risk margin. Both the IAIS¹² and the IASB¹³ 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.

Current 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 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. A discussion of discounting is included in Section 5.

What follows in this section is a discussion of the nature and key characteristics of expected cash flows, and the methodology and assumptions/inputs used in the determination of current estimates in the context of general purpose and regulatory financial reporting. Appendix B discusses specific inputs to their calculation, including those relating to mortality rates for life

⁸ 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, generally referred to as investment contracts, are not within the scope of this paper.

⁹ See the Glossary and Appendix A4 for a discussion of key terminology used in this paper.

¹⁰ IAIS *First Liabilities Paper* (2005), paragraph 22-iv and IAIS *Second Liabilities Paper* (2006) paragraphs 29 and 36

¹¹ IASB *Discussion Paper* (2007), Part 1 paragraph 90

¹² IAIS *Second Liabilities Paper* (2005), paragraph 35

¹³ IASB *Discussion Paper* (2007), Part 1 paragraph 90

insurance and annuities, claim expectations, loss (and related expense) development for claims that have already been incurred, non-claim-related expenses, policyholder behaviour and rates of contract discontinuance. These are often referred to as actuarial assumptions.

Many of the observations in the following discussion are also applicable to the measurement of the other components 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, they should not be taken to represent current best practice or standards, nor comments on IASB (2007) or any IAIS paper.

Overall, the overriding concepts of measurement as discussed in Section 3 are relevant here.

4.2 All relevant cash flows 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 for the insurance contracts. Once a contract has been sold and been recognized, the current estimate of its obligations and rights would reflect all of the related expected cash flows after the measurement (report) date on a prospective basis. In doing so, all relevant contract features, cash flows and risks should be considered.

For estimates of the probability-weighted cash flows for catastrophes/ calamities, consideration would be given to outstanding claims, as well as to future catastrophic/calamity risks (e.g., including 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”.

The expected value is the weighted average of the outcomes of all possible scenarios, weighted according to their respective probabilities. Although, in principle, all possible scenarios are considered, it may not be necessary, or even possible, to explicitly incorporate all possible scenarios in the measurement of the liability, nor to develop explicit probability distributions in all cases, depending on the type of risks involved and the materiality of the expected financial effect of those scenarios under consideration.

However, for the purposes of some reporting methodologies, a specified subset of these cash flows could be subject to different considerations, as indicated in Section 3.4.5. In those cases, a description of the treatment of relevant cash flows not included would be disclosed.

4.3 Valuation technique (methodology) and considerations regarding its inputs

Once the overall valuation approach to the assumption (e.g., market-based or non-market-based, as discussed in Section 4.4) is selected, the input parameters (assumptions) are derived. Note that it is common practice to estimate claims development after considering the results of several actuarial techniques, as the use of inputs from multiple valuation techniques can enhance the reasonableness of the current estimate. 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 behaviour, expenses, and investment returns or discount rates, and their interaction.

For a given valuation technique, each significant assumption is assessed independently and incorporated as an input to the valuation. The effect of the interactions with other assumptions (e.g., the effect of interest rates 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. However, in certain cases, the implementation of such an explicit approach may prove too complex or impractical in the circumstances.

As a unique process and method to derive assumptions may not exist, professional judgment is often needed. The results of this judgment would be assessed for their relevance and reliability. In some cases, an assumption that may apply to one portfolio might not be appropriate for another, even in the case of similar contingencies. In other cases, there may be so many assumptions involved, it can be difficult, if not impractical, 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, 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 (1) their combination would be more reliable, or (2) 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 amount and type of available data can, in some cases, determine the complexity of the model or models selected for use. The availability of only a few data points may only permit a simple model to be developed and applied. If an overly complex model is used where there is limited data, an impression of precision will be given that may be unwarranted and cannot be supported¹⁴. In addition, when there has been a short time since a major change in conditions emerged, a realistic analysis might not be practical, although this problem may diminish in importance over time as more detailed data become available.

¹⁴ If too many parameters are fitted from limited data, the results are likely to be erratic, driven more by random noise than by the underlying conditions or expectations.

4.4 Market and non-market inputs

Measurement of certain liabilities in some financial or regulatory reporting systems requires the use of market-based inputs¹⁵. For example, a standard on fair value measurement requires inputs to be reliably estimated and that they be derived from prices observed from relevant market transactions, although, in some cases, adjustments are made to transaction price information to apply to a specific circumstance. 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 prices are not available, although market-based inputs are available for certain actuarial assumptions, normally only of a financial nature.

Where used, transaction prices normally reflect all the measurement components of a liability, that is, current estimate, time value of money and adjustment for risk, the latter of which usually reflects the risk preference of market participants.

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

The derivation of the expense assumption might be a special case. Even in cases in which the accounting framework indicates that a market-based expense assumption should be used, it is not uncommon that entity-based expenses are used, due to the lack of reliable market-based expense measures. However, it may be inappropriate to reflect one-off expenses that are not expected to recur. Because of the wide variation in entity-specific unit expenses and lack of relevance of external expense sources, such as outsourced claims or administration adjustments, if desired, are usually applied to entity-level expenses to derive an estimate of market-based expenses.

4.4.1 Market inputs

Where pertinent and reliable information is available from a relevant market, measurement inputs¹⁶ reflect observed prices or related information

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

Some financial reporting systems, when alternative inputs (assumptions) might use different bases, establish hierarchies regarding what basis of measurement the item should use. In

¹⁵ These standards generally refer to market consistency. As discussed in Section 6.2, as this paper deals primarily with non-hedgeable risks for which a market generally does not exist at the time of measurement. Although it may not be possible to determine whether a method is "market consistent in practice", it is useful to consider the extent to which a methodology is "market consistent in theory"; i.e., the risk margin is based on assumptions and approaches that a market participant would use and is sensitive to changes in the market to the extent observable, i.e., market-based.

¹⁶ "inputs" are sometimes referred to as "assumptions"

some cases, current estimates use relevant and reliable current market-based inputs rather than those based on historical transactions or entity-based assumptions.

Nevertheless, information regarding cash flows relevant to the risk characteristics of the applicable cash flows would always be used, in preference to inputs solely based on transaction prices, where those transaction prices do not reflect identical or very similar risk characteristics. For insurance contracts, market-based inputs that would be generally accepted for valuation purposes, at the time that this paper was written, are primarily financial-related assumptions.

A special case arose in 2008 when many financial markets became significantly illiquid. In such cases or in cases in which a price relates to a distressed transaction, prices that are observed may not necessarily represent a true market perspective. Therefore, in such cases care is needed to ensure that prices from distressed transactions are either not used at all or used with significant adjustments.

Similarly, market price information from an over-heated market can also be distorted. In these cases prices that are observable may not necessarily represent a true market perspective. Assessing the extent, and even the need, for adjustments can be more difficult than in a distressed market, because bull markets can run for long enough that the underlying euphoria becomes thought of as being normal.

4.4.2 Non-market inputs

In the absence of pertinent and reliable transaction information from a relevant market, a valuation technique or model is used to estimate inputs based on non-market-based sources, 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 neither available nor adequate, as is often the case for a new line of business, similar relevant entity or industry experience can be used.

This approach is used in pricing a portfolio of insurance contracts, augmented where appropriate by professional judgment. For instance, although industry or population-based mortality experience can be used as a basis for a non-market-based mortality rate assumption where the portfolio is new, available observed experience of the portfolio almost always provides more pertinent 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 (i.e., adjusted to be relevant to the portfolio whose liability is being measured) may supplement the portfolio mortality experience¹⁷. Such a source more likely 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 cases, price information currently available often does not relate particularly well to the characteristics of the risks being measured. This may be due

¹⁷ A typical approach is to use an industry or population mortality table for the shape of the mortality rates, with the level of rates adjusted on the basis of portfolio data.

to such factors as the need to adjust for events that are unlikely to recur (called “one-off events”) or the inability to make unbiased adjustments that reflect the specific 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 used in the development of a current estimate. They would, for example:

- reflect the characteristics of the portfolio for which the current estimate is made;
- be comprehensive;
- reflect all reasonably possible, relevant and foreseeable cash flows related to the market input, that is, in cases of assumptions in which optionality or guarantees are involved, representative or stochastically generated relevant scenarios are considered;
- reflect a consistent set of policyholder behaviour, for example, voluntary contract termination, where appropriate;
- reflect intermediary behaviour, reflecting expected intermediary contract terminations where the intermediary's commission is not vested;
- reflect insurer behaviour, 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;
- be recognized by the financial reporting system;
- be internally consistent with other measurement inputs and the measurement approach used;
- be internally consistent with other aspects of current estimates, and the discount rate and risk margin calculations;
- be representative of the 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 in the nature and detail of the guidance they provide about 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 taken by such systems include a requirement to describe its possible effect 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 situation.

4.5 Assumptions / inputs – characteristics

Assumptions and inputs are inherent in measurement using measurement models and methodology. They are required by mark-to-model measures. Several characteristics are considered in this section, including their nature in current estimates, the use of portfolios, internal consistency and asymmetry.

4.5.1 Non-market-based assumptions – current conditions and expectations

This section deals with non-market-based assumptions or inputs. These assumptions are used to derive a current estimate, reflecting current expectations, 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 recent experience is often the best basis from which current expectations of future experience can be derived for a particular portfolio, current estimates of future cash flows would not automatically assume that recent experience will continue unchanged.

In addition, although the observed experience from the portfolio might be relevant to the portfolio as it existed during the observation period, the current portfolio for which estimates are made may differ in several respects. In many cases, it could be argued that the current portfolio is usually different from the observed portfolio, if for no other reason than the passage of time.

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 expected cash flows, unless parameters derived from past experience are adjusted. 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 suggest 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 under- or significantly over-represented in the experience of the most recent ten years.

It is useful to examine several examples of expected changes in conditions. An expected change in law, tax or regulation is usually not anticipated in the measurement of liabilities, although it may depend on the applicable financial reporting standard and the certainty and immediacy of the change. In contrast, it is appropriate to consider expected changes in most other future conditions 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 the effect of current conditions or expectations will normally not have been reflected in recent experience, but may affect future expectations if a sufficiently reliable estimate can be made as to their effect on the estimates involved. The decision regarding the extent that current conditions are directly reflected or only used as an input to the estimation process can vary by type of assumption (e.g., expense reduction effort or impending law change with possibly voluntary termination effects).

4.5.2 Non-market-based assumptions – portfolio as the unit of account

Assumptions relate to the specific portfolio (see Section 3.4.7 for further discussion) of contracts (or claims as the case may be) 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 and the composition of what will then be the portfolio. Adjustments might be needed to reflect expected changes in future conditions or to compensate for the inadequacy of available experience data of the portfolio.

For most insurance contracts, the use of a single contract as the source of observable information would not normally represent an adequate sole source for measurement input. For example, if a single contract were used as the unit of account, a large unit expense assumption would result and process risk (i.e., statistical deviation and volatility of experience due to the small size of the portfolio, discussed in Section 7.2) would be fully reflected in measurement. In fact, in the case of a term life insurance covering a single individual when the contract is in force, no mortality claim experience has occurred from which to assess the contract's future experience. At the other extreme, an industry-wide or even entity-wide basis would not be used, as the resulting assumptions would often not be relevant to the exposures, risks and obligations to which the mix of contracts or outstanding claims in the portfolio is and will be 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, as long as it remains 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*¹⁸, as used in actuarial literature, usually refers to the extent to which the information can be relied upon, while “reliability”, as used in much 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 are generally considered more relevant than that of the industry (or the general population). This is because portfolio-specific data are based on the contracts or claims being valued and already include measures of their mix of risk characteristics, coverages, marketing and underwriting selection, adverse selection reflecting policyholder behaviour, and claim management. Nevertheless, when fully credible portfolio-specific data are not available, industry (or general population) experience data might be useful, although adjustments are often needed to reflect differences in the risk characteristics involved (possibly as a supplement to or validation of the assumptions made) or in the case of a new line of business.

The volume of available 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 tradeoff between using more data, which would result in using older data that need more adjustment, and using less data that are more reflective of current conditions, but may not be as credible.

¹⁸ More discussion on the use of credibility is included in Section 4.7

4.5.3 Non-market-based assumptions – updating

When current expectations are used to derive estimates of non-market assumptions, all relevant assumptions would be reviewed on every reporting date, and updated as appropriate. The process used is thus similar to the application of market-based assumptions. In fact, all assumptions need to be reviewed on a regular and systematic basis at each measurement date. However, although a review is performed at each measurement date, an update to every assumption may not be needed unless significant credible new information becomes available to suggest that an update is appropriate¹⁹. Currently, it is not unusual to perform a more rigorous review of all key assumptions on an annual basis.

In a financial reporting system that does not permit the application of updated estimates, but rather requires locked-in or non-current assumptions to be applied, estimates may be required to be updated as a result of a liability adequacy, loss recoverability, or premium deficiency test. Nevertheless, it could not be said that such a locked-in system or one in which each assumption is not reviewed involves fully current estimates. Even in a locked-in system, the assumptions for new business require regular review.

The measurement of the 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 the context of the measurement. 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.

Financial reporting usually 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. An update to an estimate may have to be significant before it is required or permitted by applicable financial reporting guidance. Nevertheless, except in the case where the choice of an assumption is constrained by an accounting rule (such a lock-in requirement), an update would be permitted if the accounting consequence is not material, even where such an update would not be required. Regular small adjustments to assumptions may help to avoid the need for large changes later, particularly if there is an indication of a trend, or low-credibility data suggesting that a larger change is in progress.

Changes in assumptions can arise for several reasons, including:

- A previous assumption may have been based on poor quality or limited data. The applicable accounting standard would be applied to determine whether an accounting error existed. More accurate data or an expanded source of experience data can enhance the accuracy of a current estimate, resulting from an improved understanding of the situation.
- Available experience data previously used may not be actuarially credible because of a limited amount of available experience data or because the observed experience reflected conditions that are not expected to continue. Note that credibility is a

¹⁹ The aim is for the measurement of liabilities to reflect changes in the underlying experience, but not random variation around the underlying experience.

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 the cash flows are more consistent with probability distribution B. Or more knowledge is obtained regarding cash flow drivers or their interactions.
- 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 in the past on the basis of the then available data, but newer observed data indicates a mean of 120 and a standard deviation of 15. In this case, recent experience has superseded or becomes more relevant than prior experience.

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 requirements of the financial reporting system and are reviewed periodically.

It is best practice to document the reasons for and effect of adjustments made to an assumption. In addition, where there is a change in experience or other information, and assumptions were not changed, the reason why an assumption was not adjusted is also normally documented.

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 their effects may be 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 for mortality rate determination and a change in development factors for claim liability estimation are usually considered to be changes in estimates, while the introduction of a mortality trend when one was not previously used or a change from a market-based to a non-market-based discount assumption may be 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 on or disclosed separately in some financial reporting systems.

4.5.4 Consistency of assumptions

If two or more current explicitly determined assumptions are related, that is, they are either positively or negatively correlated, any relationship will be reflected in current estimates in a consistent manner. For example, mortality experience can be affected by earlier contract discontinuances. When the best potential mortality risks are able to buy other contracts with lower premiums so that increased discontinuance leads to anti-selection, a higher subsequent mortality assumption is appropriate. Another example would be that policyholder behaviour may be linked to interest rate or interest crediting 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 permit non-guaranteed elements to be recognized, 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 behave in a manner consistent with those assumptions. The result of such constraints would be an unrealistic current estimate that does not reflect the combination of all relevant and pertinent assumptions that would otherwise be made.

In some cases, the cash flows during a given period depend significantly on the outcome of prior cash flows, while in others they are independent of them. The former might indicate the use of an assumption regarding the mean reversion in certain types of cash flows, such as returns on investment and capital. 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 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 observed experience under similar current or expected economic and competitive conditions may not be available.

The consistency of assumptions over time is an important issue to be considered, relating to the extent of responsiveness to reported changes in experience. In addition, consistency across assumptions is important to consider; for example, the relationship between inflation and interest rates. In general, it is preferable to revisit assumptions on a regular basis, to avoid waiting for a large catch-up change. Actuarial credibility can provide a conceptual basis for adjusting assumptions to the extent justified by the latest relevant experience. This helps to avoid large offsetting changes in successive periods.

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.

4.5.5 Asymmetry of expected losses or benefits

Expected cash flows can be influenced by the following factors:

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

Often a non-symmetric probability distribution would be applicable, for example, 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. Other non-symmetric examples include guarantees (a minimum cash value or interest rate credited, or a 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 its application

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 (e.g., a contract in which anti-selection can occur or where a minimum investment return is contractually guaranteed) are involved, the use of a stochastic method considering the entire range of scenarios, using an asymmetric distribution may be appropriate. Alternatively, validated representative deterministic assumptions might produce sufficiently similar results. 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, nor for an understanding of the range of probable future scenarios.

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. A *general stochastic approach* typically uses many stochastic paths generated from the initial point in time.
2. A *nested stochastic approach* is one in which stochastic scenarios are generated, starting 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 different *nested stochastic approach* uses a pre-determined 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).

4.6 Approximations

Approximations can sometimes be made for individual assumptions or for aggregate estimates so that they can be developed in a relatively simplified manner and yet still produce reasonable estimates in compliance with the requirements of 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 used for practical reasons. Nevertheless, they have to be applied in a technically sound manner to meet the requirements of a financial reporting standard. For example, a mid-year assumption for cash flows often represents a sufficiently accurate estimate for the purpose of estimating the timing of future annual cash flows, the average age in a quinquennial age grouping may be appropriate in many situations and a mid-month assumption

for cash flows during that month. Such simplifications may not always be appropriate, depending on the facts and circumstances involved. For example, using mid-year or mid-month assumptions in cases in which premiums are all received at the beginning of the year or the month would be inconsistent with that assumption.

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 technological constraints. It is not uncommon that as technology is enhanced (usually with more powerful computers or more efficient software), more refined models, for example, 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 considered may depend upon the circumstances and the materiality and importance of the calculation. Although in some cases the consideration of more scenarios results in a more accurate calculation, this will not always be the case. Limited increase in accuracy will occur when the cash flows are not particularly sensitive to the number or range of scenarios considered or when a likelihood distribution is very tight. In some cases, professional experience will help determine the general extent of this sensitivity, while sample tests may be needed to determine sensitivity or trial and error testing may be needed to determine, for example, the number and range of scenarios to consider. Using a set of representative scenarios or a representative best estimate scenario may be adequate, although in some cases it might be better to test the technique selected rather than simply assume it is an adequate basis.

Both the IAIS²⁰ and the IASB²¹ have referred to the use of probability-weighted cash flows. These references 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 cash flows in the middle (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 of the expected cash flows to directly estimate a mean value. Alternatively, suitable calculations may be derived that do not use a complete probability distribution.

There are many examples of practical alternatives to the use of stochastic methods. For example, a limited number of representative scenarios can be used to capture the effect of the range of possible policyholder behaviour or a range of possible investment returns. Also, for property and casualty insurance claims liabilities, judgmental weights can be applied to the results of multiple estimation methods to derive a set of expected cash flows.

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

²⁰ IAIS *First Liabilities Paper* (2005), paragraph 22-iv and IAIS *Second Liabilities paper* (2006), paragraphs 29 and 36

²¹ IASB *Discussion Paper* (2007) Part 1 paragraph 90

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. 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 item to which the approximations are applied. Periodic testing, including the use of roll-forward methods in some cases, to assess the continued acceptability of the approximations may be necessary.

4.7 Quality of data and credibility approaches

In some cases, only limited or unreliable data may be available from the insurer's experience of a particular type of contract or claim from which to base an assumption for that contract or claim. 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 they are not available, from industry or population sources. If appropriate, adjustments are made to these alternative sources so that they are more consistent with 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 sources of experience, to set appropriate weights for the different sources 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.

Inward (assumed) reinsurance can present a particular challenge when the data made available by the cedants are 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 that a lower bound of a range of estimates of a liability can be determined that represents the lowest value in a reasonable range of estimates), although certain accounting literature indicates that, where no reliable basis exists, no value would be included in the balance sheet. Rather, 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.

Where limited data are available, actuarial credibility theory can provide a sound basis for combining estimates from different sources of pertinent data sources and for updating those estimates as new data becomes available. Typically, some directly pertinent data from the

contracts are considered, as well as collateral data from a variety 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 increase their relevance to the estimation. After such adjustment, actuarial credibility can be used to develop a weighted average of the various estimates. Nevertheless, the extent of any adjustments made is monitored and considered when setting the risk margin.

Actuarial credibility can also be used to combine a smaller body of recent data with a larger volume of older data. In many cases, where it is not clear that conditions are unchanged, the factor applied to the most recent experience can be increased, on account of the possibly lower relevance of the older data.

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 that can be determined in a reliable manner, although it is usually not clear how such a minimum value would be derived.

5. Discounting Cash Flows

5.1 Introduction

An economic principle relevant to the measurement of liabilities for insurance contracts is that, in almost all circumstances, a given amount of money, payable now, is worth more than the same amount of money payable at a later time. This time value of money can be measured using discount rates to value what a future cash flow is worth today. The discount rates applied to the cash flows associated with an insurance contract depend on the time until the cash flows will be paid, that is, the discount rates as a function of time form a yield curve. The objective of applying discount rates to future cash flows as part of the calculation of a current estimate is to place a value on a set of future cash flows, reflecting the time value of money.

A discount rate may be based on the rates of investment return expected on a set of assets that will or could provide for the cash flows related to the obligations of an insurance contract. These investment return expectations might be based on a market's current assessment of the time value of money (as observed through transaction prices) or on the time value of money implicit in a given set of current or expected future assets. Where possible, discount rates should be derived from observable and objective information and should vary with the term of the applicable cash flows. A current assessment reflects estimates based on a current set of expectations or prices.

Discount rates can depend on whether a contract's obligations are either (1) directly linked to the investment return of a designated portfolio of assets or contract-specified asset portfolio or (2) not directly linked to such performance. In some cases, the distinction between these two forms of obligations is not clear-cut. In those cases, such a linkage may relate only to part of an obligation or may only loosely relate to such performance. Other factors may also be involved in such cases, such as regulatory requirements. Although most of the remainder of this section is devoted to the second type of obligation, the first type is discussed in Section 5.5.

The existing bases for discount rates used in the measurement of a current estimate of the liability differ, in some cases dramatically, depending in part on the financial reporting requirements and objectives under which the discounting is determined and on the contract type involved. For example, if a current exit value approach is used, the views of applicable market participants would apply. 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).

If, according to the applicable measurement attribute, a liability is to be measured independently from the actual assets held by the reporting entity, its measurement does not depend either on a particular block of assets or an entity's investment strategy. This, in part, is because assets are fungible and can be replaced, either by the reporting entity or an actual or hypothetical entity to which they would be transferred.

The following is an approach that might be used, if there are no other requirements to be applied. A transferee places a value on a specific liability, based on a set of assets that would reproduce the expected cash flows associated with the insurance obligation with minimum deviation (a replicating portfolio, also referred to as a minimum risk portfolio). If used, an additional margin for the risk of any remaining mismatch between the liabilities and their corresponding assets would be included as part of the liability.²² Further, a replicating portfolio would be revised in a manner consistent with subsequent changes in the expected cash flows.

If there are no relevant observable market rates for assets that make up a replicating portfolio whose cash flows are comparable with the characteristics of the liability, then the applicable reporting framework may provide guidance. A pragmatic solution would be to use the yield curve or interest rates from the most similar assets for which observable prices are available. For example, if there is no market in a jurisdiction in which risk-free securities are traded, or if such securities are not available at a duration as long as a duration of a cash flow from an insurance contract, then prices for the closest available duration or similar securities might serve as the base from which the estimate would be derived. An adjustment to represent the estimated difference in price would be made. Note that either the applicable financial reporting context or standard might provide guidance as to how such an adjustment might be made or whether a completely different approach should be taken.

Several methods have been used to extend a yield curve for terms beyond the longest available rate in the market. The simplest approach would be to use the last available rate (e.g., the 20-year market rate for a 30-year cash flow). A more refined method would be to extrapolate the yield curve on the basis of the shape of the yield curve at shorter durations. One such approach is to assume that the forward rate observed between the last durations during which market rates are observed remains constant. When limited relevant market data are available or when the term of the cash flow is significantly beyond the last available market rate, then a model could be applied to extend the yield curve.

Such an extension of the yield curve could be viewed as constituting a non-hedgeable risk to be considered in determining a risk margin. One could also use a financial model like the one described in Hull-White (1990) or a parity relationship such as the real interest rate parity convergence as discussed by Ferreira and Leon-Ledesma (2003). If applied in a rigorous manner, any of these approaches can provide an assessment consistent with reporting frameworks and financial economics and might be considered a market-consistent basis for discounting purposes.

The probable range of total investment returns can significantly affect certain elements of liabilities for insurance contracts; for example, in deriving the cost of certain contractual options and guarantees. However, a discussion of specific models, including those involving future yields on equity instruments, is outside the scope of this paper.

If discount rates are modeled stochastically, two approaches can be taken: (1) develop different scenarios, each with its own set of expected cash flows and discount rates consistent with the

²² Such a portfolio attempts to capture the effects of financial market changes on the cash flows, i.e., the impact on the value of options and guarantees. It does not capture the effect of changes to non-hedgeable risk (for example, insurance risk) and hence while the replicating portfolio provides a sound basis for the determination of discount rates, a risk margin is needed to reflect non-hedgeable risks in the liability valuation.

scenario, with the results of each scenario weighted to derive the present value of the set of cash flows or (2) weight the cash flows in each scenario by the probability of that scenario and then apply the current yield curve to the applicable expected cash flows. Method (1) has usually been applied by giving equal weight to each scenario if the cash flows are dependent on the path of investment returns, the path of discount rates, or ending market conditions, although a more robust approach would incorporate probability-based weighting to better allow for low probability scenarios. In addition, if market-consistent current estimates are desired, the resulting discount rates should be consistent with market yield rates.

An accounting framework could require or permit mean-reversion interest rate or equity yield models, particularly in what appear to be historically extreme market conditions. The resulting discount rates are not usually considered to be market-consistent.

Alternative approaches to determining discount rates currently, at least to the extent allowed by the reporting framework, include the use of high quality long-term bond assumptions, deflators (particularly if equity assets are included in a linked set of assets), or average historical long-term experience.

Those who contend that the expected investment returns of the current and expected future assets should be used as the discount rates support their position by pointing out that this is the basis upon which they price their contracts and business combinations, and in this sense is consistent with these market prices and thus with actual sale transactions. In addition, they also represent factors in the determination of key benchmarks with which they manage and monitor their business performance.

An alternative argument is that, when assets are held at book or amortized cost and liabilities are measured based on market discount rates, the use of such investment returns, to project liability cash flows and as the discount rates, compensates for the mixed attribute model of accounting. However, this approach is inconsistent with many current measurement attributes and those under development that measure liabilities independent of a specific set of assets. In addition, the financial market crisis of the last part of 2008 illustrates a situation in which this accounting approach could encourage inappropriate risk-taking on credit spreads. Further, this approach is inconsistent with the law of one price, a fundamental principle of financial economics, if the same market value of investments can result in lower liability values when the investments have more credit risk. To the extent possible, consistent measurement attributes as used, for example, in a fair value measurement, should be used for both assets and liabilities for financial reporting and to facilitate high quality risk management practice.

In cases in which discount rates by term have limited influence on the result of liability measurement (e.g., in a short-term residential property insurance contract, or when there is a relatively flat yield curve), a single average discount rate may represent a suitable approximation to the yield curve. If an equivalent average discount rate is used, it would normally be determined in such a way that its application results in a liability similar, subject to materiality considerations, to that obtained by using the complete yield curve. It may need to be reviewed on a regular basis to ensure that any difference remains immaterial. The equivalent weighted average rate may provide a useful benchmark for comparison purposes²³.

²³ This is a required disclosure in Australia

Although this section includes a discussion of alternatives and of matters to be considered in relation to the economic basis for determining a discount rate, further guidance may be needed in a particular situation. If further explicit guidance is needed for external reporting purposes, it might be provided by regulatory rules, financial reporting standards, professional standards, or industry practice as it emerges. To the extent that relevant financial reporting standards or regulatory rules are not sufficiently specific, economic, accounting and actuarial principles or guidance would be considered, as described in applicable literature.

In the remainder of this section the following conceptual topics related to the determination of the discount rates to be used to measure the liabilities of insurance contracts are discussed:

- The composition of interest rates (Section 5.2)
- Risk-free rates (Section 5.3)
- The liquidity premium that might be added to the risk-free rates (Section 5.4)
- Linked and related approaches (Section 5.5).

Some take the view that an allowance for non-performance (also referred to as credit characteristics of the insurer's obligations, "own-credit standing", or "non-performance risk") should be incorporated in the discount rates. This approach is common practice for loans and many other financial instruments with respect to their values as assets, since they are priced in this way. In contrast, credit risk is not necessarily related to the time period involved in insurance contracts, where it is better related to the sources of uncertainty and the cash flows to which it relates. Thus, discount rates may not be the most appropriate base to which it should be applied for insurance contracts. Further discussion on the credit characteristics of the liability is included in Section 8.3.

5.2 Composition of interest rates

A description of the composition of interest rates that might influence the choice of discount rates is provided in this section. The structure of interest rates can be viewed in several ways, depending on the overall accounting objective. It is commonly viewed in two segments:

1. "Risk free rate", which really is not risk free, but at least excludes most credit risk. This is usually looked at in terms of the sum of the following:
 - a. Real interest rate.
 - b. Inflation expectation or time preference for the duration of the cash flow.
 - c. Sovereign provision (the credit risk of the national government's securities), that includes both the expected sovereign risk and the price for uncertainty for the sovereign risk that can result in different interest rates by jurisdiction.
 - d. Less other elements. These are usually unobservable and negligible in size, but include the effects of such factors as extreme market aversion to risk, a desire to indicate to others the safety of the securities, and the cost of safe keeping, the aggregate amount of which is evidenced by the implied negative yield rate for three month U.S. Treasury bills on December 9, 2008.

2. The difference between observed market interest rate and the then “risk free rate”. In each such formulation, this component includes:
 - a. The expected effect of credit defaults over the duration of the cash flow being discounted. In some cases this factor only reflects the effect of the probability of default, while in other cases it also incorporates the expected severity of the loss associated with defaults,
 - b. A premium for the uncertainty of the effect of credit defaults over the duration of the cash flow being discounted, sometimes referred to as the beta premium. This compensates the investor for the uncertainty associated with the actual default cost being different from that expected.
 - c. A liquidity margin, the price that market participants require for bearing the risk that the financial instrument will not be able to be sold immediately without incurring a substantial price discount,
 - d. A premium for the uncertainty of the effect of liquidity,
 - e. In some jurisdictions and for certain securities and certain investors, differential tax treatment of returns, such as in the U.S. between municipal and corporate bonds, or in Australia between pension funds in the draw-down phase and other investors,
 - f. Cost due to a contract feature. The conversion cost if the contract or other instrument whose price is observed is convertible into equity or another contract, although in some insurance contracts such a conversion would likely be reflected in expected cash flows. The cost of any call or prepayment options included in the cost of the instrument whose price is observed, for example, a callable bond.
 - g. Other elements, including:
 - i. Small sample bias – the market may require an allowance for more extreme events than are observed from historical data.
 - ii. Skewed nature of payoff – investors usually require additional compensation for skewed risk profiles, particularly a capped upside and heavy downside.
 - iii. Correlation effects with interest rates – the required credit spread (components 2a plus 2b) might be reduced due to the correlation between credit spreads and interest rates.
 - iv. Differences in the nature or imperfections of the markets involved, either structural or one-time, for example, differences caused by current forces of supply or demand, even though the effects of market arbitrageurs would be expected to minimize this effect if there were a perfect market. Note that some of these imperfections may be captured in the liquidity premium (components 2c plus 2d).

In addition, if the issuer incurs expenses related to the management of a set of assets, these expenses may be expressed as a percent of asset value, or if incurred at the acquisition or disposition of the assets, in terms of those specific asset classes. These expenses may also be accounted for separately as a cash flow related to investment expenses. In any case, the expenses related to the management of the assets are reflected in the overall measurement, but care is needed to avoid either not including any of these expenses or double counting them. These expenses can include fees charged by a third party investment manager, investment

commissions, or the cost of internal management in charge of the investment function, and is likely to be higher for non-liquid securities than those tradable in an established market.

Nevertheless, the expected investment expense used is normally that consistent with the discount rate used; that is, if a risk-free rate is used, investment expenses would be those consistent with securities yielding such an interest rate. In this case one would expect that not only would any investment earnings in excess of the risk-free rate be recognized in a performance report, but also that investment expenses in excess of those related to risk free investments, due to a different investment strategy, would be recognized as a cost at the same time.

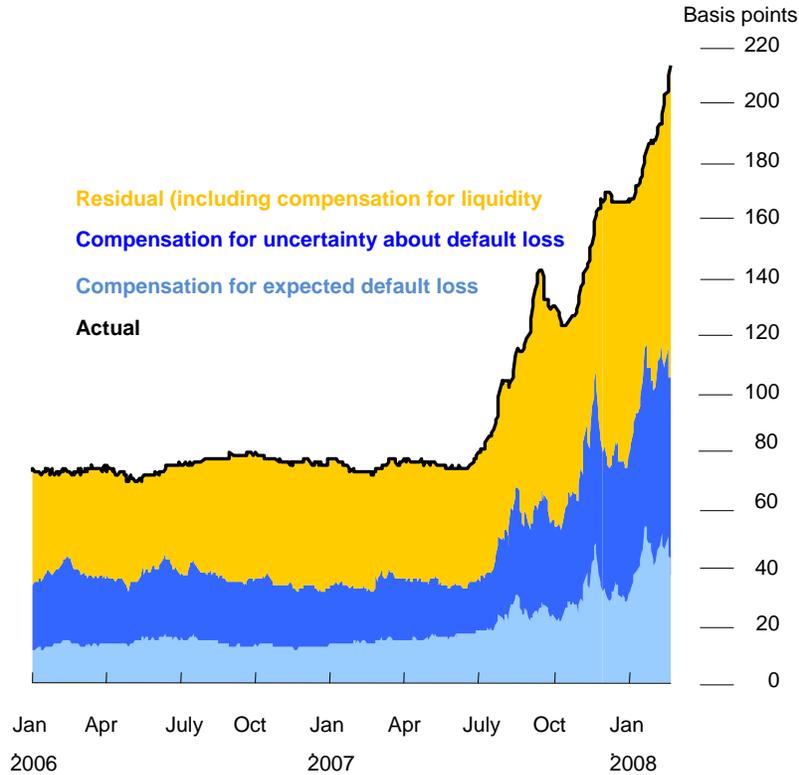
It is unusual for prices of components of an interest rate, such as the provision for expected credit risk, to be observed independently. Instead, as interest rates are observed, subtractions or additions are estimated explicitly or implicitly for the components, based on other factors. This can arise in either developed or undeveloped markets.

In some cases, the individual components of an interest rate are combined or reformulated. For example, the decomposition of the risk-free rate (segment 1 above) into its component parts is not commonly made. If not observable, the aggregate amount of segment 2 above, after taking into the effect of $2f$, if any, has sometimes been estimated as the sum of the entity's own credit premium plus a small adjustment factor (equal to the observed market rate for the contract's expected term, less the risk-free rate, and less the entity's own credit premium). The adjustment factor represents the sum of the liquidity premium and the other, usually minor, factors which, under normal conditions, are relatively small.

Due to the difficulty in obtaining reliable market-based data applicable to an insurance contract, it is not uncommon to look at the total credit default premium, combining expected defaults (segment 2a above) and the risk associated with these defaults (segment 2b above). Similar difficulty has been experienced in separating the credit premium (segment 2a plus segment 2b) from the liquidity premium (segment 2c plus segment 2d).

A graphic display of one such decomposition is shown in Figure 5.1. The components shown in Figure 5.1 include the market's current risk preference that changed dramatically, beginning about July 2007 and continuing through the date of this paper.

Figure 5.1 Decomposition of sterling-denominated investment-grade corporate bond spread



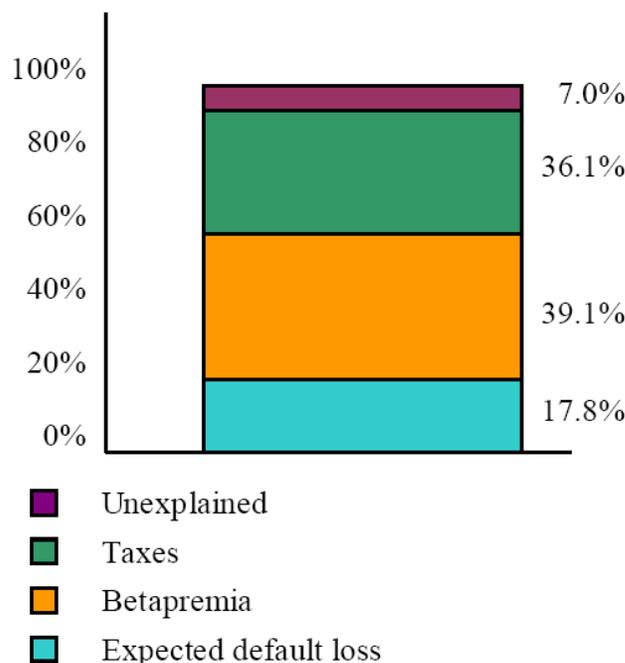
Sources: Bloomberg, Merrill Lynch, Thomson DataStream and Bank calculations.

For details of the method underlying the decomposition, see Webber, L. and Churm, R. "Decomposing corporate bond spreads" 2007 Q4 *Quarterly Bulletin* pages 533-41.

The provision to compensate for the uncertainty associated with default risk and liquidity risk is often based on observed market prices for this uncertainty that is included in nominal yield rates in excess of (1) the expected default-free yield and (2) the expected default cost for the type of asset involved. In many cases, distinguishing between these elements is quite difficult. Alternatively, if observable and reliable, prices for relevant credit default swaps (CDSs) have sometimes been used to calibrate credit margins.

The overall credit spread of corporate bonds has sometimes been expressed in terms of the elements shown in Figure 5.2. Note that the percentages are based on 2005 data.

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)*

Credit risk is usually 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.

If corporate bond rates are used as the starting point in determining discount rates and credit spreads are not to be reflected in discount rate for insurance liabilities, the price for credit (expected defaults plus uncertainty risk) is usually estimated and then deducted from corporate bond yields to derive appropriate discount rates. In a few markets, particularly in the U.S., historical studies (including those from Merrill Lynch and Moody's) have indicated that the expected cost of defaults usually run anywhere from 20% to 50% of the margin between corporate bond prices and risk-free rates, although there has been limited reported experience from other markets to confirm a more general result.

However, in practice, it may be difficult, if not impossible, to quantify each element separately in a robust manner. Certain techniques have been developed to decompose some of them (e.g., Churm and Panigirtzoglou (2005), Leland and Toft (1996), and Merton (1974)). However, they tend to be complicated and usually solve for a residual factor. For example, the combination of the liquidity premium and risk margin for default risk could be obtained from a market-observed rate less the risk-free rate for that duration and an estimate of the applicable expected default cost over the duration, with the expected liquidity premium derived from an applicable market. Another method described in Webber and Churm (2007) derives credit-related risk premiums from equity prices, assuming that these capture corporate earnings prospects and market risk preference. These methods to date have proven problematic due to their complexity and the assumptions needed to derive them.

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 than government bonds, if it is decided to incorporate a liquidity premium as a component of the risk-free rate, this approach will, at least in theory, provide a (default) risk-free rate for less liquid instruments or contracts.

5.3 Risk-free discount rates

In practice, a risk-free rate represents observable rates from an active market (one with narrow bid-offer spreads) from which price data is available for an instrument that is often thought both to carry negligible credit risk and to be highly liquid, both desirable characteristics. It is important to note that “risk-free” in the context of determining discount rates refers to being free from the default risk of the instrument or contract, although generally other risks, such as market, inflation and sovereign (default) risk, remain. In addition, since capital markets vary widely among jurisdictions in terms of types of securities/instruments traded and their scope, depth and liquidity, the best basis for risk-free rates can correspondingly vary.

In selecting the basis for risk-free rates for a particular situation, pragmatic considerations, rather than those of an overly theoretical nature may need to be emphasized, as there may not be a “true” risk-free rate. Such a rate is sometimes considered to be a starting point for determining other yield rates, and thus can be applied as a reference rate rather than a theoretically pure one.

Since there is no unique source for risk-free rates, the following are possible bases for them (to the extent they are permitted under the applicable reporting framework) and are considered in this section:

- Government bond rates (5.3.1)
- Government bond rates plus an adjustment (5.3.2)
- Corporate bond rates minus an adjustment (5.3.3)
- Swap rates minus adjustment (5.3.4)
- Swap rates (5.3.4).

Figure 5.10 shows five sets of rates, including bonds rated at three credit levels. Note however that this figure is somewhat dated.

In the case of an insurer that expects to earn interest at a rate greater than the risk-free rate (most insurers believe that the market prices effective interest at a conservative rate), a loss at issue of an insurance contract with a heavy savings component may result if discount rates used are at a risk-free level. This may be overcome if the discount rate chosen is greater than the risk-free rate, possibly including a liquidity premium or other adjustment. (See Section 5.4 for further discussion)

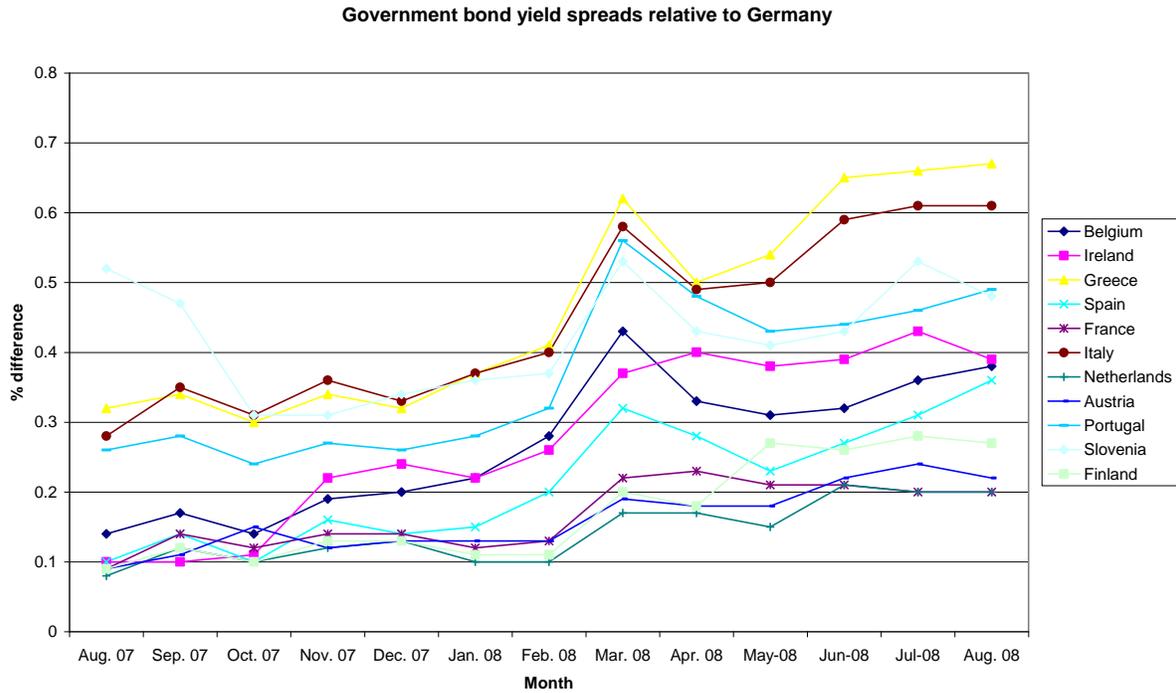
5.3.1 Government bond rates

Government bond yields of the jurisdiction of the entity are often considered to be the closest to risk-free that can be observed from market transactions and, in some cases, may be the only measure that is directly observable without needing adjustment. Most governments borrow money with minimal default risk due to, among other potential actions, their ability to tax their citizens.

The disadvantages of using a currently tradable government bond yield measure include:

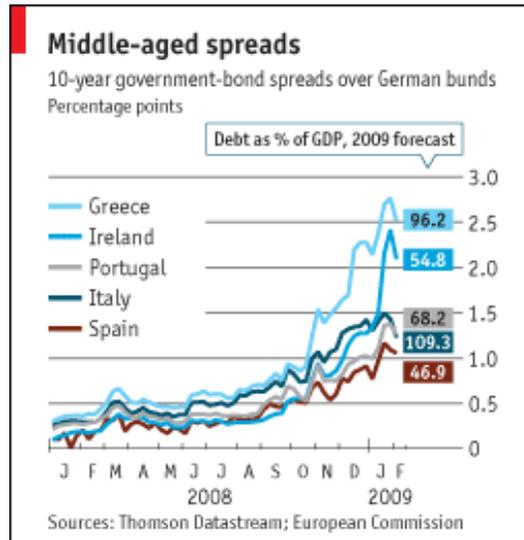
- A limited number of outstanding terms for long-dated government bonds may provide only a few observable points from which to base the long-end of the yield curve.
- Government bond prices can be distorted, due for example to an artificially high supply provided by governments during a period of time or a demand from sources such as financial institutions and pension funds that may be subject to regulatory constraints that favour government bond holdings. Distortions also can arise on particular dates, such as the end of the financial year, and for bonds issued at a benchmark duration (e.g., a ten-year bond whose yield might be 50 basis points lower than either a nine- or eleven-year bond). It should also be noted that the latest price for thinly-traded bonds may be for an earlier date and/or affected by the particular circumstances involved. 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 a jurisdiction in which the government has run a surplus or in a jurisdiction with limited capital markets. For example, Norway currently does not have any outstanding government bonds. On the other hand, prices of government securities might include a “liquidity premium”, reducing their yields below a risk-free level, as discussed in Section 5.3.
- Even if available, government bond prices applicable to a given currency may vary significantly. For example, Figures 5.3 and 5.4 illustrate the variation between yield rates of selected European countries using the euro. The variation would be greater if a wider selection had been used. Note the significant increase in this variation that arose in 2008 illustrated in Figure 5.4.

Figure 5.3 Variation in European government bond yields



Source: European Central Bank data

Figure 5.4 Variation in European government bond yields in 2008 and early 2009
(Economist, February 7, 2009)



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 in a market for which trades occur for a particular duration. If a call option is included or if a constraint is placed on

the bond or the market, appropriate adjustments may nevertheless be able to be made to determine the price/yield corresponding to a zero-coupon basis (see Section 5.3.2).

5.3.2 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 basis for the liability for insurance contracts.

A common distortion in available price information is the short supply of government bonds at the long end of the yield curve. As a result, it is very difficult to quantify yields for these durations and to make an adjustment for this effect.

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 U.K., 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. Since the repo-ability of government bonds is not relevant to liability valuation, this premium can be added back to the government bond yield when valuing the liability.

This view is also expressed in the U.K. Board for Actuarial Standards Guidance Note 45, paragraph 4.1.3, used 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, although that is somewhat outdated at the date of this paper.

In the U.K., 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 an ongoing analysis of the GC repo curve.

While the use of a “government bond yield plus” measure might eliminate an important distortion, it can often be conservative or prudent due to other non-quantifiable market distortions. In addition, 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.

5.3.3 Corporate bond rates minus an 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 further adjustments for 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 government bond market does not exist in the jurisdiction. However, it does assume a consistent price difference in corporate bond and government bond markets had a robust government bond market existed.

Expected defaults are typically based on well-known studies of historic default data, although the time period over which the study is done can affect the absolute levels of defaults. For example, Table 5.5 was developed from Merrill Lynch data for the U.S. bond market during the period 1997 and 2003 showing average spreads and expected default losses over the seven year period. It shows both the market credit spread and the spread based on expected defaults for four selected bond terms. Note that the relative difference between the two spreads tends to decrease as the credit rating gets worse and debt gets longer (except at extremely poor credit ratings where the market assumes the worst over the short-term. Note also that differences in credit spreads have experienced extreme variation during 2008. In contrast to early 2007, corporate bond spreads in developed markets were extra-ordinarily large at the end of 2008 (not shown in the table).

Table 5.5 U.S. corporate bond credit spreads 1997 – 2003
(values in basis points)

=> => Increasing term to maturity => =>								
Credit rating	Market 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

The difference between the market yields of corporate bonds and government bonds reflects the market charge for default risk and consists of both (1) expected credit losses and (2) the effect of uncertainty associated with these losses. Although both factors vary over time, since it is the second that typically varies significantly by market perception over time, it is assumed to be the one that has varied most in the last part of 2008. 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. One of the components of the spread in this case represents the price for the credit risk uncertainty, with the mix of these components can and often does vary by credit rating and duration, as well as over time.

5.3.4 Swap rates minus adjustment

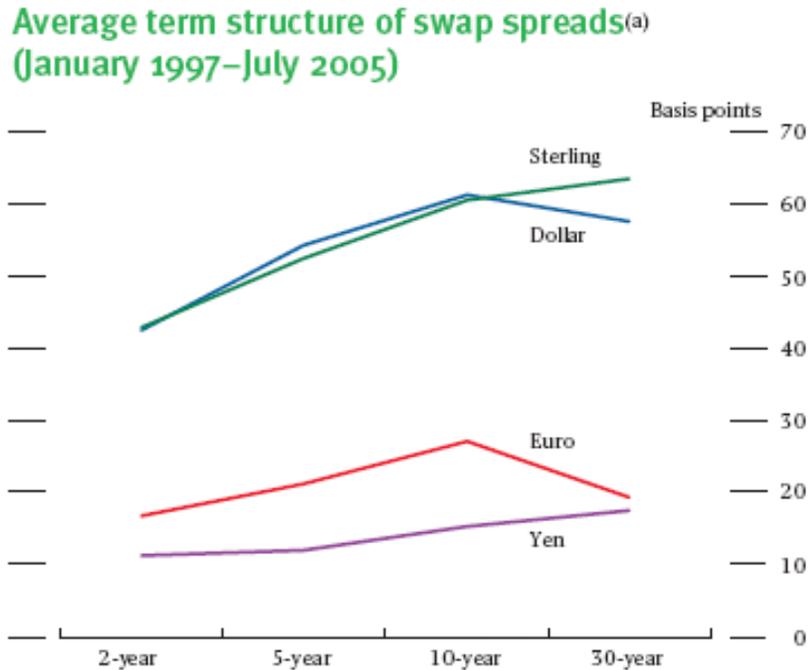
Given the disadvantages of starting with corporate bond rates, a more promising alternative may be the use of swaps as a basis for the risk-free rate. The following definition is from the Bank of England.

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 London Interbank Offered Rate (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 market prices for corporate securities at long durations may not be available in a jurisdiction. In less-developed markets, swaps often only trade at durations up to 10 years, while even in most developed markets swaps do not extend beyond 30 years. In some jurisdictions, the swap market has become more liquid than the government bond market, but its main advantage is that this liquidity often extends to a longer duration than available in the government bond market and may, therefore, represent a more robust and reliable basis for determining discount rates for long-term insurance obligations. Note that, in general, swaps hedge market risks but not credit risk.

Figure 5.6 shows average historic swaps spreads over government bond yields.

Figure 5.6 Average term structure of swap spreads (January 1997-July 2005)



Source: JPMorgan Chase and Co.

(a) Since Japanese 30-year government bonds were not issued until 1999, this article uses yen swap spreads of 20-year instead of 30-year maturity. Before 1999, deutschmark swap spreads are used to proxy for the euro area.

In developed active markets swap spreads over government bond yields are typically positive. For a jurisdiction in which government bond markets are less developed and therefore less liquid, or where governments have low credit ratings, negative spreads are possible. For example, this situation arose in the Czech Republic in 2008.

Swaps are over-the-counter (OTC) contracts, primarily transacted between two counterparties who are both financial institutions. The credit risk relates only to achieving the floating leg of the swap. The credit risk inherent in the floating leg should equally be reflected in the fixed leg of the swap and be adjusted for in any measure of risk-free rates.

A majority of the swap market is usually either collateralized or operates through margin accounts. Where this is the case, the 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 the government bond as collateral.

This would result in a loss by the entity equal to the difference between the LIBOR rate that is due on the swap and the GC repo rate that is earned. Nevertheless, its result character would

be close to risk-free²⁴. This loss could therefore be seen as an allowance for default risk, the 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 5.7 shows the government bond (zero gilt), LIBOR and GC repo rates in the U.K. at the end of 2005 over a one year time horizon, with the horizontal axis referring to the time horizon up to a year in this case. Note the downward sloping (inverted) yield curve inherent in prices at the end of 2005.

Figure 5.7 LIBOR compared with repo rates

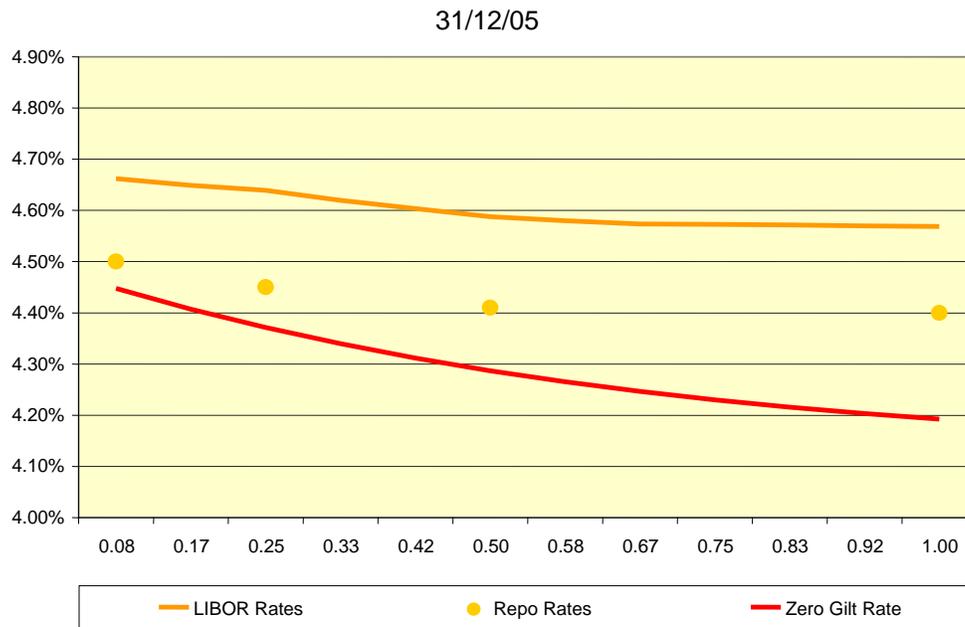


Figure 5.6 shows that, for the relevant six-month LIBOR term, the spread of LIBOR over the GC repo rate was around 20bp at the end of 2005.

Between 2005 and 2007, swap spreads over government bonds have generally been about 30bp (for a maturity of 10 years). This implies a spread over government bonds during that period of about 10bps. Note that the size of the spread can differ significantly between jurisdictions.

In contrast, spreads can increase significantly in periods of market turbulence when a flight into risk-free and liquid assets was observed such as in late 2007 when U.K. spreads widened to 70bp (with a maturity of 5 years), with an even larger spread in 2008.

The significant increase between the end of 2007 and the end of 2008, as seen in Figure 5.7, was a period of significant market turmoil and volatility, during which these spreads have been

²⁴ A repo might be subject to the default risk of a lender if the lender refuses to return the collateral involved, although due to what is generally the high quality of the collateral, it is often viewed as being close to default-free.

at historically high levels. In major financial markets, 3-month LIBOR diverged sharply from overnight interest rates on interbank lending. In these markets, this reflects banks' assessment of the risks they have undertaken in lending unsecured funds for a specified time period during which the borrower may encounter difficulties. It represents the cost of their funds.

In contrast, overnight lending has usually been viewed as being relatively safe, since under normal conditions it is rare for a default to come as an overnight surprise, although in the U.S. in the fall of 2008 even these rates showed a sharp increase, as banks were reluctant to expose their bank's funds during a period in which those funds might be needed to cover possible bank cash shortfalls.

Nevertheless, some observers believe that an overnight rate such as a SONIA or EONIA (Euro OverNight Interest Rate) might be appropriate for a very short-term period, with longer rates based on LIBOR, with both interest rates being appropriately adjusted.

Figures 5.8 and 5.9 provide an indication of the volatility that can occur in periods of financial illiquidity as evidenced by experience during 2008. Figure 5.8 shows the difference between the three-month T-bill interest rate and three-month LIBOR (TED spread), along with its standard deviation over a ten year period, both through July 2007 and between August 2007 and January 2009. Figure 5.9 shows the difference between yields of corporate bonds rated Aaa and Baa and U.S. Treasuries.

Figure 5.8 TED spread²⁵

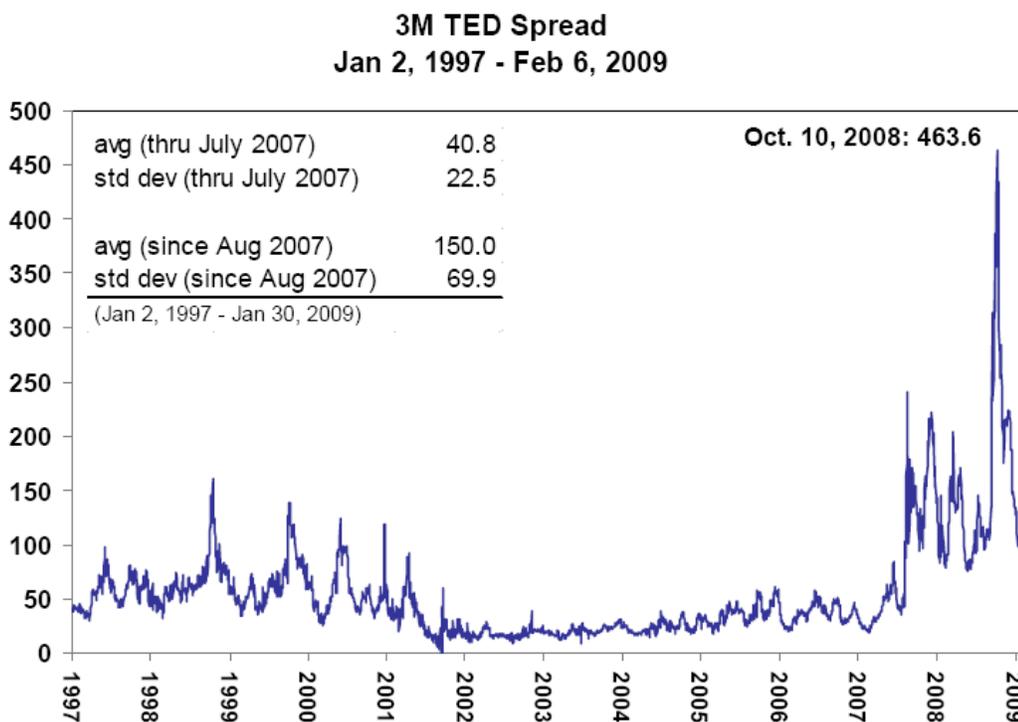
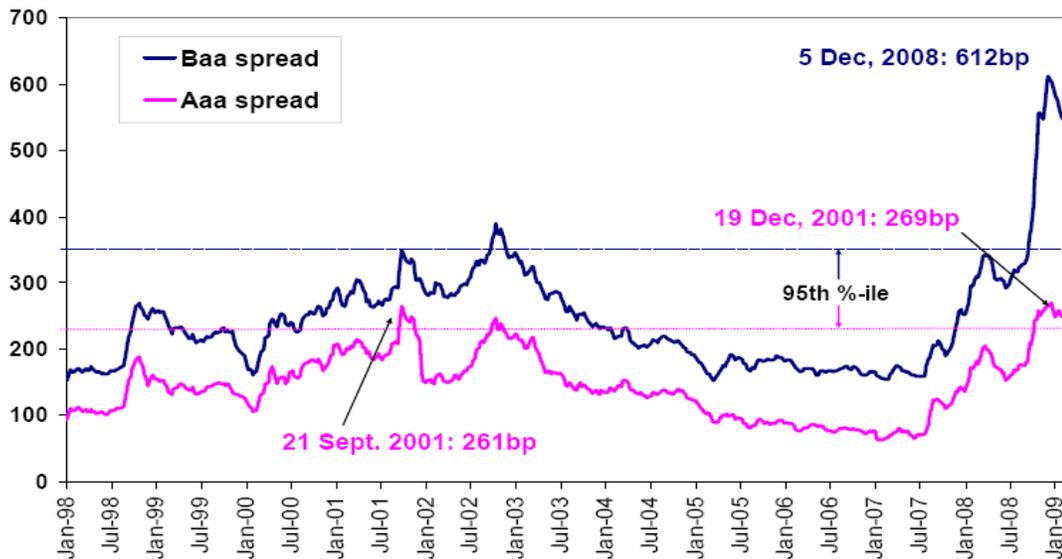


Figure 5.9 U.S. bond credit spread²⁶

²⁵ T. Schuermann, presentation at the Bowles Symposium, February 2009

²⁶ T. Schuermann, presentation at the Bowles Symposium, February 2009

Baa and Aaa Spread (to Treasury)
 weekly, Jan. 2, 1998 - Jan 30, 2009



Given what happened during 2008, it may be difficult to justify the use of unadjusted swap rates as risk-free, although it should be noted that the comparison given above refers primarily to rates at short durations.

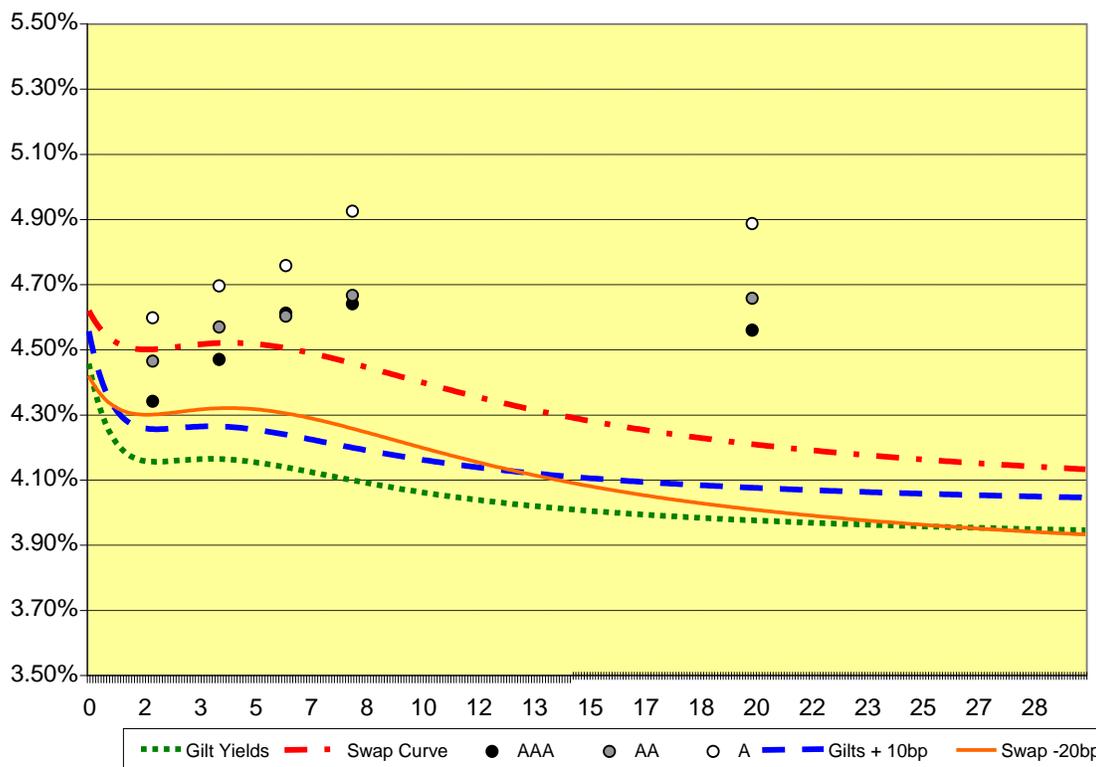
The Chief Risk Officer (CRO) Forum has presented this benchmark, indicating that swap rates, less an adjustment, are typically the most liquid, complete and reliable risk-free rates available. In the case of the measurement of most insurance contracts, this is more conservative than would be produced through the use of discount rates that include an allowance for the credit spread of the insurer itself (or that of the counterparty to which the liabilities would be transferred in the event of insolvency if of higher credit quality). In any event, as noted in Section 5.1, this paper does not presume that the liabilities' credit characteristics are necessarily related to discount rates, although if observable the market assessment of these characteristics might prove to be a useful benchmark from which to measure market risk preferences.

5.3.5 Comparison

Figure 5.10 shows a comparison between several possible measures, including those discussed above that are candidates for use as risk-free rates, as of the end of 2005 over terms up to 30 years (note that in this graphs gilts refer to government bonds).

Figure 5.10 Possible bases for discounting

31/12/05



5.4 Liquidity

5.4.1 The liquidity premium

The risk-free rates discussed in Section 5.2 are based on rates expected to be earned from highly liquid securities such as government bonds or interest rate swaps. However, to the extent that it is appropriate for discount rates to be based on the liquidity characteristics of the expected cash flows inherent in the liability (or asset), the discount rates instead should correspond to interest rates that are somewhat greater, that is, based on securities that are less liquid than the risk free securities.

The term “liquidity” has been used to represent many things – in this section it refers to the extent to which a liability or an asset can be converted to cash or a cash equivalent as desired, without a substantial price discount at a given point in time. It should be noted that in some cases it has been used to represent the term premium, representing the effect of longer-term time value of money. It can also reflect volatility in market price prior to maturity. In addition, it may incorporate information risk, representing the lack of appropriate price information regarding current conditions, market preferences or the characteristics of the instrument or contract being measured. It has more commonly been applied as a characteristic of an asset than of a liability. As a result, neither literature nor practice has yet developed to derive a universally accepted application of this concept to liabilities.

However, in the context of this paper it is more relevant to discuss liquidity from the perspective of a liability. In other words, the simple fact that there is an observable liquidity premium in asset prices may not be sufficient to indicate that liquidity premiums should be reflected in the measurement of a liability for insurance contracts. Nevertheless, if liabilities are replicated with hypothetical securities that match the liabilities and these assets incorporate a liquidity premium (if you would use the inherent discount rates in these assets to discount the liabilities), such a premium would automatically be included in the value of the liability.

The financial instruments featuring risk-free rates are generally highly liquid, which means that they are easily tradable and exchangeable. Liquidity can be compared to an option to sell the financial instrument in a short period of time. This liquidity is clearly a valuable attribute of these assets (and a component of the risk-free rate in the real financial market).

Many insurance liabilities do not provide the policyholder with the same degree of liquidity as a government bond²⁷: (a) Typically, the (policyholder) has little or no ability to sell its contracts to others. ... (b) In some cases, the (policyholder) cannot cash the contract in early; in many other cases the (policyholder)²⁸ has a contractual right to cash in early, but would suffer significant contractual deductions or other disadvantages for doing so. Therefore, it seems to make sense to give consideration to liquidity aspects in the discount rate for insurance liabilities. The discount rate should ideally reflect the liquidity needs generated by the insurance liability." (IASB: Information for Observers, Insurance Working Group, November 2008, *Discount rates and day one losses*, paragraph 9)

For the purposes of liability valuation, the extent of liquidity to be reflected in the associated cash flows would be provided by replicated assets with similar liquidity characteristics. If a liquidity premium is included in the calculation of a liability, then its estimation is relevant. Its relevance may also depend on the extent that liquidity is important to potential transferees or market participants, if their view or market prices are used in measurement.

If it is decided that liquidity should be considered in the measurement of liabilities of insurance contracts, how it should be reflected? If measurement considers scenarios of deterministically-determined cash flows, discounting could be determined on an entirely illiquid basis, since the liquidity premium results from (1) weighting each possible cash flow scenario by its probability considering its level of liquidity and then (2) applying a risk margin relating to the inherent liquidity risk.

For a liability, this would represent an addition to the risk-free rate to be used for discounting purposes. 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

²⁷ This assumes that a government security is the basis for a risk free rate.

²⁸ Note that original text had "insurer" rather than "policyholder" in error in three places.

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 usually require less liquidity in their asset portfolio is that many obligations of an insurance contract have a relatively low or reasonably predictable on-demand turnover for a portfolio, and some obligations such as payout annuities cannot be surrendered at all or not without substantial penalties. In such cases insurance liabilities require less liquidity in its backing assets. However, observed prices for illiquidity in assets do not provide information in respect of the liquidity in liabilities. This is especially the case when surrender options exists. As a result, if a market-consistent measurement is desired or required, the margins for surrender rates should be comparable with the liquidity premiums observed in the applicable market. No adjustment should be made without market-based reasoning.

What matters most is the degree of uncertainty regarding the timing of the ultimate cash flow to be paid from whoever holds the assets to whoever is owed the obligations. If the obligation can be transferred to another insurer, this should not alter the timing requirement of the ultimate cash flows, 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 reflected in the valuation, a further question is whether the liability for different types of insurance contracts should have different liquidity premiums. In theory, this depends on how illiquid the liability is. Any increase in the uncertainty in the timing or amount of liability cash flows should increase the liquidity premium.

On a portfolio basis, the liquidity needs relative to the uncertainty of cash flows that exists at a contract level is reduced somewhat, providing the insurer an opportunity to earn a liquidity premium, even for contracts with call risk (such as mortality or surrender risk).

For example, annuity payments depend on survivorship for which an expected value can usually be developed based on the experience of a portfolio or similar portfolios. Experience on contracts that can be surrendered would be considered more uncertain, as the timing of payouts can depend on the policyholders' behaviour and reactions to economic or other events, although this may also be impacted by surrender penalties and or other restrictions (e.g., in products that include a tax benefit for the client). Arguably therefore, immediate annuities should be valued using discount rates that reflect less of a liquidity premium in the prices of the relevant assets (i.e., higher discount rates) than would be appropriate for many savings contracts that can be surrendered on demand.

The implications for longer-tail general insurance contracts differ according to the line of business and specific risks involved. To the extent that the payouts are less predictable as to

amount and timing, lower discount rates (i.e., reflecting assets containing a liquidity premium) would apply. For example, workers compensation liabilities that predominantly reflect weekly benefits are more predictable (less liquid) than similar liabilities where the claimant can redeem weekly benefits for a lump sum. Common law liabilities are less predictable still, but note that, in the claim settlement process, a general insurer can usually control the claim payout timing to some extent through the claim settlement negotiation process.

Short-tail general insurance, on the other hand, can contain significant catastrophe risk, with highly unpredictable fluctuations (as measured at contract issue) in terms of losses. While reinsurers can provide some support for the resulting demands for liquidity for the settlement of claims, direct insurers writing such business need to hold substantial liquidity in their assets.

5.4.2 Estimating the liquidity premium

A significant body of literature exists that attempts to demonstrate the estimation of liquidity premiums in corporate bond spreads. Most of these studies focus on the U.S. bond market, although an increasing number have been made on the basis of credit default swap (CDS). Limited research has been conducted regarding the effect of liquidity on prices of liabilities, although the concept of studying bid-asked prices may be useful to consider.

A 2004 study by Longstaff, Mithal and Neis focuses on evidence from the CDS market to eliminate a default-related component from corporate bond spreads. They identify a relationship between the resulting non-default component and several indicators of liquidity (e.g., bid-ask spreads) on the data set on the basis of regressions. The average liquidity premium measured range from 50 basis points for AAA/AA bonds to 72 basis points for BB bonds, although the implicit liquidity premium tends to increase significantly when credit spreads are extreme in amount.

The larger liquidity premium 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. As a result of this correlation and due to what is usually considered to be a more easily determined market- basis for credit risk, it is typical to observe credit spreads, and then implicitly determine the liquidity premium. Note that, in some cases, it can be difficult to determine whether the primary driver of the value of a bond is more related to credit or liquidity risk. This contributes to the difficulty in estimating the liquidity component. In a distressed market, part of the credit spread is linked to the condition of the holder of the financial instrument rather than the issuers. Observable prices may be depressed if buyers are scarce and potential sellers are squeezed for funds.

Other studies based directly on corporate bond data have derived lower estimates. For example, Driessen (2005) estimated a liquidity premium of about 10 basis points for a BBB bond, while Li, Shi and Wu (2005) estimated that the liquidity premium explains 25% of the spread for investment grade corporate bonds, although others have derived higher values or percentages of such spreads. In February 2008, Charlie Bean, deputy governor of the Bank of England, indicated that half of this margin was due to illiquidity, although various studies near the end of 2008 have suggested that this proportion was higher.

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 to the effect of 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 based on experience from the periods derived.

A U.S. study (Longstaff, 2001) 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 have the identical credit risk to 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 premium in Treasury bond prices. The study finds that the average liquidity premium during the period studied lies in the range of 10bp to 16bp, depending on the term of the bond.

Other studies of U.S. Treasury data have derived estimates of liquidity premiums 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 that may reflect differences in liquidity. 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 adjustment might be justifiable for liability cash flows with a high degree of predictability and hence illiquidity. A lesser liquidity premium would be expected to be applied in the case of less predictable cash flows.

Nevertheless, in the stressed market conditions in last half of 2008 or in cases in which there is no market, due to among other things the virtual shut-down of many markets and willingness to trade, the liquidity premium can be substantial. As in other areas, to be consistent with a market-consistent approach, the measurement of the liquidity premium would be based on current observable market inputs.

Gintschel and Wiehenkamp (2009) show that liquidity in fixed income markets, based on the difference between corporate bond spreads and CDSs, is significantly associated with the returns of a wide range of fixed income markets. They assume that this difference is a practical surrogate for a liquidity premium. Further, they found that the liquidity premium is time-varying, that is, varies by duration, as well as being related to credit rating.

A recent example (October 2008) of a practical approach to approximating this premium was a decision made by the Danish Ministry of Economic and Business Affairs, with the agreement of the Danish Insurance Association, that for a temporary period discount rates for pensions for maturities of more than seven years would reflect a liquidity premium of fifty percent of the difference between the weighted, option-adjusted credit spread on bonds in Nykredit's mortgage bond index (covered bonds) and the ten year Danish swap rate.

5.5 Linked (and related) obligations

If a cash flow is directly linked to a designated portfolio of assets or contract-specified asset performance, an alternative discounting approach may be appropriate and may even be

required by the relevant reporting standard. Rather than reflecting the time value of money in a market-consistent manner, the objective of a financial reporting system might 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 an insurer's obligation is directly linked to the insurer's investment performance, some form of transfer of the performance of the investments to the policyholder occurs. As a result, the measurement of the obligation should be consistent with the measurement of the corresponding assets. To the extent that linked assets replicate the obligation (or a fixed proportion of it) entirely, its liability would equal the reported value of the linked assets. In that case, no discounting would be needed for measuring the obligation – the measurement of that aspect of the liability would simply be that of the linked assets.

However, if there is a cap or floor on the performance of linked assets in determining the obligation, a discounted cash flow approach is an appropriate valuation technique. This would also be the case where the linked assets are not entirely pre-determined, but depend upon the investment policy of the insurer.

Valuation techniques are also needed if the linkage is in part at the discretion of the insurer, in which case the reporting framework may provide guidance as to how to reflect the expected effect of discretion. The measurement approach for such deviations from full direct linkage should be similar to the measurement approaches used for non-linked obligations. In such cases, the projected cash flows of a contract would reflect the expected investment returns and expected reinvestment rates on the specified set of assets, as well as their expected uncertainty. The assumptions concerning policyholder behaviour would need to 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 in the policyholder behaviour assumed.

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, are:

1. a bottom-up approach, where the discount rate would equal:

the risk-free rate applicable to the expected cash flow durations (see Section 5.3)

- + a margin for retention of some or all of the corresponding liquidity premium (see Section 5.4)
- + a credit characteristic premium for the insurance contract/financial instrument
- investment expenses (if not covered elsewhere) appropriate for a set of risk free assets, often expressed in basis points
- + a margin for non-diversifiable asset-liability mismatch risk to the extent a replicating portfolio cannot be used.

If the investment expenses of the assets held differ from investment expenses based on risk-free assets, the difference would be reflected as a distinct liability.

2. a top-down approach, where the discount rate would equal:

the total nominal expected investment rate for the applicable expected cash flows (including management's anticipated return)

- the expected asset default cost
- an asset default risk margin to reflect its uncertainty
- investment expenses (if not covered elsewhere) appropriate for the assets
- a margin for non-diversifiable asset-liability mismatch risk.

These are expressed in terms comprising fixed income security assets. They would be modified for other types of instruments.

The first approach is closer to the approach used for non-linked cash flows, although, in the general case, some or all of these margins may be explicitly applied to expected cash flows rather than implicitly, as adjustments to the discount rate.

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

Examples of contractual linkages include participating contracts in certain jurisdictions and variable or 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 this case the liquidity risk is identical to the liquidity risk of the corresponding assets.

If the contract's benefits are linked to an index (e.g., in the case of inflation-linked benefits), the discount rates would be expected to be developed from assets whose cash flows are also linked to the same index. However, where index-based swap rates or securities are not available or if index-based securities are only available for a limited number of terms, risk-free rates would likely be adjusted to match the expected index outcomes.

When establishing a discount rate for a contract whose obligation is indirectly based upon the insurer's invested assets (e.g., universal life insurance and life insurance or annuity contracts with excess interest sharing), a combination of linked and non-linked approaches might be appropriate although, practically, such a combination could become quite messy to calculate. Similar approaches should be used in cases where the transfer of investment returns is at the discretion of the insurer.

In the related, but not identical situation of a contract in which the cash flows are indirectly but imperfectly linked to the performance of designated assets, the effect of expected portfolio composition (including changes in the entity's asset mix) could be estimated; for example, based on observed policyholder sales illustrations and planned management investment strategies, so it may also be appropriate to link the expected yield (and hence cash flows and discount rates) to expected investment performance, even though there is no direct "formula" linkage.

Note that while the approach described above results in an internally consistent measurement basis, it would generally not be considered to be market-consistent, unless the future investment returns are based on market rates rather than on the expectation of the entity for its future investment returns.

To achieve a market-consistent approach for participating contracts under which the underlying assets are bonds and excess investment earnings 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 within the current market yield curve) provide information on the value of the excess interest likely to be granted to the policyholder. However, these values are not certain and, in reality, the future rates 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 practice, swaption prices or stochastic modeling can be used to calculate the value of the profit sharing. However, because minimum interest rates are guaranteed in this example, it is not sufficient to only consider a single scenario for future yields, 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 and desirable characteristics for the use of risk margins (*margins over current estimates* in IAIS terminology, as discussed in Sections 6.1 and 6.2) and how several approaches to its measurement might be applied in theory and in practice (in Sections 6.3 through 6.5). This section also includes a quantitative and qualitative comparison of the approaches (in Sections 6.6 through 6.11).

Appendix C provides further details supporting this section. Appendix D shows one life insurance and one annuity example prepared in more detail than the examples given in Section 6.5. Appendix E provides further discussion on the measurement of the effects of diversification on risk margins, while Section 7 contains a broader discussion of the effects of various risk mitigation techniques.

In this section, unless otherwise specified, references to the views of the IAIS refer to IAIS views expressed in its 2006 *Second Liabilities Paper*²⁹ and references to views of the IASB refer to IASB preliminary views expressed in its 2007 Discussion Paper³⁰.

6.1 The objectives of risk margins

Although a risk margin could be derived to meet a variety of risk objectives, or even as a more or less arbitrary addition to the current estimate, to determine a reasonably consistent, useful and meaningful liability for a specific type of contract, it is important to formulate its objectives as clearly as possible.

In discussing the objectives of risk margins, it is necessary to understand the context in which they apply, that is, the nature of an insurance contract.

In general, under an insurance contract the insurer agrees to provide, in exchange for a payment of one or more premiums, a set of benefits to a beneficiary upon occurrence of specified contingent events affecting the lives or property insured.

Two viewpoints regarding such a contract can be distinguished:

1. Policyholder view. Policyholders are subject to risks as to the frequency, timing and/or severity of contingent events that they cannot or do not wish to bear themselves, considering their own assessment of the cost and benefits of transferring those risks; and
2. Insurer view. The insurer has the ability to manage these risks through one or more risk management techniques, including the pooling of similar risk exposures, making use of flexible contract features, diversifying the risks across multiple risk pools, reinsuring the risks, or securitizing the risks.

²⁹ IAIS *Second Liabilities Paper* (2006)

³⁰ IASB *Discussion Paper* (2007)

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

Until the transferred obligations are settled, the insurer bears a current obligation. That obligation is measured for use in both regulatory and general purpose financial reporting as a liability. It is generally agreed that such a liability should consist of an estimate of the expected present value of cash flows plus a risk margin. The risk margin reflects the uncertainty associated with the expected cash flows.

Two perspectives on determining the amount of risk margin will be referred to in the following: the “policyholder protection” and the “provision for the cost of bearing risk” views.

6.1.1 The risk margin for “policyholder protection” as an element of prudence

Ensuring that the promises made by an insurer to its policyholders will be kept is a primary objective of the insurance regulatory function. To that end, the methods and to some extent the assumptions by which rights and obligations are valued in regulatory financial reports can be subject to regulatory rules or control, as is the amount of capital that an insurer needs to remain in business. The type and extent of the authority available to the regulator with regard to the use of methods and assumptions underlying the valuation of liabilities and amount of capital needed to avoid regulatory action differs by jurisdiction and has changed over time.

Regulatory financial reporting regimes usually prescribe that rights and obligations must be valued in aggregate on a conservative basis that covers adverse deviation in the expected cash flows that can be expected under moderately adverse circumstances. The amount of capital required by the regulatory function represents an additional provision, and thus serves as a second level of protection to cover more adverse outcomes.

Setting risk margins in liabilities from the “policyholder protection” viewpoint requires an understanding of the distinct purpose of risk margins and capital. Regulators require and policyholders benefit from a level of insurer liabilities and capital such that total insurer resources are sufficient to cover obligations to policyholders with a high level (probability) of assurance. Although the quantitative distinction between risk margins and capital can appear somewhat arbitrary, the principle underlying their combination is reasonably clear. To reflect that quantitative arbitrariness, there has been a tendency toward thinking about a total balance sheet approach that reflects the overall level of security achieved.

A total balance sheet approach to determining required capital requires that if risk margins were higher (or lower), then the required capital would be correspondingly lower (or higher). This would then naturally imply that requiring capital to be a specified percentage of the liabilities will not simultaneously satisfy both levels of assurance

6.1.2 The risk margin as a provision for the cost or price for bearing risk

For the bearer of the obligation, there is a cost associated with the risks of providing an insurance contract. This cost can be quantified in terms of the market³¹ price for offsetting the risks. In essence the cost and price views represent the same concept looked at from different perspectives – a relevant marketplace participant and the bearer of the obligation.

In evaluating the risk margin from the frame of reference of the bearer of the obligation, in this case the insurer, it is useful to discuss the two perspectives – the first is described in 6.1.3 is expressed in terms of the market price for the risks resulting from the contract, and the second is described in 6.1.4 is expressed as a cost to the insurer.

6.1.3 The risk margin as a provision for the price for bearing risk – exit value approach

The IASB (2007) proposed that the risk margin in a general purpose financial report should be determined so that the current estimate plus risk margin represents a *current exit value*, that is, “...the amount an insurer would expect to pay at the reporting date to transfer its remaining contractual rights and obligations immediately to another entity”³².

Where a deep and liquid market for a class of insurance obligations exists, a reasonable exit value (corresponding to a price) would be observable in that market. The exit value determined from these price observations would naturally include a provision reflecting the current market view for the price for bearing the risk associated with the insurance contract. Alternatively, such a price can be viewed to represent the corresponding *reward or compensation* for bearing risk by the insurer from the perspective of market participants.

In many cases the financial component of insurance cash flows can be hedged or replicated by financial instruments (e.g., securities and derivatives) available in a market³³. In these cases, it would be possible to refer to market prices for similar cash flows for measurement purposes. In the terminology used in this paper, while a market price includes both a current estimate of expected discounted cash flows and a risk margin in excess of that amount, in assessing a market price it is not usually possible to separately identify these components.

In most cases, a market for insurance risks such as mortality³⁴, morbidity, and unpaid claim obligations does not now exist³⁵. Such risks can therefore be considered non-hedgeable. This is not necessarily a characteristic of the risk, but rather represents the absence or characteristics of a market in which such risks are actively traded. If a market for these risks

³¹ *Market* is used as a general term here; the capital market is one type of market for refinancing capital in case capital has been depleted.

³² IASB *Discussion Paper* (2007) Part 1 paragraph 93, page 59

³³ Hedging a set of cash flows is not always possible. For example, some of the cash flows generated by a portfolio of life insurance contracts could be expected to occur at a duration longer than that of currently available hedging instruments. The term “hedging” under IFRS is a defined term referring specifically to matching with derivatives, while the term is used here in a broader sense, equivalent to matching or replicating.

³⁴ There are some exceptions to this, e.g., a limited market for longevity risk and a larger market for catastrophe risk, but these exceptions do not affect the non-hedgeable nature of major areas of insurance risk.

³⁵ Some argue that such market will never exist, given the heterogeneity of these risks

develops in the future, the risks, although unchanged, could then be considered hedgeable. When reliable prices from such a market are observable, they would be considered.

In the meantime, both the IAIS *Second Liabilities Paper* (2006) and the IASB (2007) have suggested that the value of the liability for non-hedgeable risks should be determined using a model having three building blocks³⁶: the current estimate of the future contractual cash flows, a discount reflecting the time value of money and a risk margin³⁷. In IASB (2007), the IASB listed several ways that this risk margin might be determined.

This three-block model assumes that, under normal circumstances, a transferee would require more than the current estimate (even if the transferor and transferee were to exactly agree on the level of the current estimate). Otherwise, the transferee would not receive anything for taking on the risk that everything does not work out as expected, which is not realistic. The risk margin can therefore be regarded as an additional amount related to the uncertainty associated with the future financial return from the contract. The risk margin represents compensation to the transferee for the risk of taking on the obligation of a set of uncertain cash flows.

Under a market-consistent approach, a reasonable basis for determining this risk margin might be to apply the approach used by the transferee to determine the additional amount (price) it would be satisfied to take on the risk, although of course what a transferee would desire would be as high a price as possible. In a reasonably efficient market (i.e., in a non-forced sale situation), the basis for the expected price would be a reasonable return in the context of current market conditions. In any case, the margin would be based on a reasonable return that appropriately reflects the risk the transferee will associate with the uncertainty of these cash flows. The price at which an efficient market clears by matching buyers and sellers will not include an amount for currently diversifiable risk. Hence the price of a risk margin would also reflect the risks and returns of a diversified portfolio of risks available to the transferee. If, in contrast, in the case of a non-forced sale in a less active and liquid market, observable evidence exists that potential transferees would only take on the net obligations at a high return in relation to the uncertainty involved, then the risk margin would reflect this higher return.

Under this view, the risk margin can be estimated by various methods that would incorporate knowledge or judgment as to what a rational market participant in the transfer market would require at the time the measurement is to be made.

6.1.4 The risk margin as a provision for the cost of bearing risk

Unlike the current exit value view described in 6.1.3, under an accounting system in which either (1) it is recognized that reliable prices for an insurance contract cannot be observed or (2) the objective is to directly measure the current estimates and risk margins of the current insurer, the basis for the risk margin would be determined according to the insurer's cost of bearing risk. It

³⁶ Note that the IASB *Discussion Paper* (2007) Part 1 paragraph 90 indicated that "an insurer should measure all its insurance liabilities using the ... three building blocks." However, in the context of this paper, the building blocks are applicable to non-hedgeable risks, i.e., where reliable market inputs are not available. For risks where reliable market inputs are available (the hedgeable risks), these inputs would include associated risk margins and hence the three building block approach would not apply.

³⁷ IASB *Discussion Paper* (2007) Part 1 paragraph 90 refers to a margin that consists of a margin for risk and service. The discussion in this section refers to the risk margin component (see Section 8.1 for a discussion of service margins).

is useful to explore both the conceptual and practical differences between this cost notion and the market-based price notion of 6.1.3.

Because, by law or regulation, the obligations inherent in an insurance contract have to be borne by an insurer for which regulatory capital is required, it is customary and common practice in the insurance industry to describe risk in the context of the capital needed to bear it. The cost of maintaining this required capital is a necessary cost of operating such a business. Practically, this capital sets a floor under which a risk margin that incorporates this cost should not fall, under either 6.1.3 or 6.1.4, since no party could bear that risk without the cost of this required capital.

It should be noted that this required capital is not necessarily determined on a purely economic assessment of risk. Consequently, to operate such a business in an economically sound manner, the cost may be better viewed in terms of the economic capital³⁸ associated with the business. An appropriate level of economic capital could be determined reflecting the entity's level of risk aversion and its desired agency rating level and market share. Historically, this has sometimes been determined as using a multiple of the level of required regulatory capital as a convenient metric for this purpose.

Note that, although some relevant discussion has been included in Section 6.9 and Appendix C, the purpose of this paper is not to determine the proper level of capital or how it should be determined. However, further discussion of the types of risks that these formulations would reflect can be found in Section 6.2.

6.1.5 Relationship between the various risk margin perspectives

The policyholder protection and provision for a price or cost for bearing risk perspectives are clearly related.

From the policyholder protection perspective, the risk margin provides for the ability to absorb a reasonable degree of uncertainty in experience related to an insurer's rights and obligations. If experience during a period is at least as favourable as that assumed in the current estimate plus the risk margin, the release of the risk margin creates a profit during that period that serves as a reward for the investor that has taken on the risk. If experience is worse than expected by less than the expected release, some of that expected release is absorbed and a smaller profit emerges. If the actual experience is worse still, the reported loss is partly offset by the expected release of margin. In the long run, the whole of the risk margin is available to cover adverse deviation.

This is the same perspective an investor would have in taking over the liabilities, as the margin for uncertainty defines the expected reward for providing for deviations from the expected costs, that is, the margin is price for bearing the risks. The cost of bearing risks perspective assesses the overall effect of measures taken consistent with business needs, including adequate capital. Any favourable difference between the assessed costs of bearing risk and actual costs is available as profit for investors, while any unfavourable variation reduces profit.

³⁸ The amount of funds in addition to the amount of an entity's liabilities that it is deemed necessary to operate the risks associated with the business.

At first glance, differences might exist between the insurer's perspective that would reflect an entity-specific view of the assessment of the risk in the cash flows, and that of the investor who would use a market view. For example, the entity-specific view of an adequate level of risk margin might not be consistent with the extent of risk aversion of investors. However, the real question is whether or to what extent an entity-specific assessment of these risks differs from a market view.

For the risks that are addressed here, that is, currently non-hedgeable risks such as expenses, mortality, morbidity, policyholder behaviour and non-life risks, it is generally assumed that the entity-specific and market views are not quantifiably different. Even within the same product category, the profile of the insurance liability outflows can differ significantly from one entity to another. This can be due to variations in the servicing platform used and hence the expense structure, as well as to variations in the underwriting or demographic characteristics of the insured perils or population and by the underwriting practiced by the insurer that affects the aggregate risk of the portfolio.

As a result, both the market- and entity-specific assessments of risk must consider the specific characteristics of the portfolio. Therefore, if applied appropriately, both views would result in a similar assessment of the underlying non-hedgeable risks.

The only remaining issue is whether the policyholder, entity and market's degree of risk aversion is consistent. Note that the IAIS view that, as stated in its *Second Liabilities Paper* (2006), insurance regulators desire to adopt an approach to liabilities that would not result in a difference from the approach taken in general purpose financial statements.

From the provision for bearing risk perspective, a transferee would need to settle the obligations in a manner reasonably consistent with the manner with which the transferor would have been obliged to do. View 6.1.4 also views the uncertainty in a manner consistent with the settlement of the obligations by the transferor. The IAIS has recognized that policyholder protection must be provided for in any transfer of liabilities, as indicated in the following statement in its *Second Liabilities Paper*, paragraph 11³⁹: "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".

Thus, the transferee would need to provide capital or in any case to demonstrate its ability to cover losses from its resources. The risk margin then represents the expected price for providing that capital or an equivalent economic guarantee, which in turn equals the price a market participant would accept for taking on the risk. In summary, the outcome would not depend on the view taken.

³⁹ IAIS *Second Liabilities Paper* (2006), paragraph 11

6.2 Desirable risk margin characteristics

In this paper, the RMWG assesses various risk margin methods against a variety of characteristics that might be considered desirable. The selection of those characteristics is discussed below.

Firstly, in its *Second Liabilities Paper*⁴⁰, the IAIS takes the position that, “without prescribing any one method at this stage, the IAIS believes that any methodology for calculating the risk margin should share certain characteristics”.

It then continues, “irrespective of the particular methodology chosen, acceptable methods should reflect the inherent uncertainty in the expected cash flows and would be expected to exhibit the following characteristics:

- 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 duration⁴¹
- 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.”

The IASB (2007) identified the same properties as being desirable.⁴²

Secondly, the RMWG believes it is desirable for the risk margin methodology to have the following characteristics, some of which are taken from a Group Consultatif⁴³ study of risk margin methods. A risk margin methodology should:

1. Apply a consistent methodology for the entire lifetime of the contract;
2. Use assumptions consistent with those used in the determination of the corresponding current estimates;
3. Be determined in a manner consistent with sound insurance pricing practices;
4. Vary by product (class of business) based on risk differences between the products;
5. Be easy to calculate;

⁴⁰ IAIS *Second Liabilities Paper* (2006), paragraph 57

⁴¹ In section 6.11 we explain that this characteristic, when evaluated in light of specific risk margin methodologies, has two possible interpretations.

⁴² IASB *Discussion Paper* (2007) Part 2: Appendix F4, page 34-35

⁴³ Groupe Consultatif (2007). Solvency II Risk Margin Comparison, February 2006
http://www.gcactuaries.org/documents/ceiops_rmcomparison_130206.pdf

6. Be consistently determined between reporting periods for each entity that is, the risk margin varies from period to period only to the extent that there are real changes in risk;
7. Be consistently determined between entities at each reporting date, that is, two entities with similar business should produce similar risk margins using the methodology;
8. Facilitate disclosure of information useful to stakeholders;
9. Provide information that is useful to users of financial statements;
10. Be consistent with regulatory solvency and other objectives; and
11. Be consistent with IASB objectives.

Thirdly, the RMWG also considered the role of market-consistency as a desirable characteristic in assessing a risk margin method. As this paper deals with non-hedgeable risks for which a market generally does not now exist, the RMWG agrees that it is not possible to determine whether a method is “market-consistent in practice”. However, it is useful to consider the extent to which a methodology is “market-consistent in theory”, that is, that the risk margin is based on assumptions and approaches that a market participant would use and that the risk margin should be sensitive to changes in the market to the extent observable. However, being market-consistent in theory is not necessarily the same as being market-consistent in practice.

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

Others believe that the effort to arrive at market-consistent values, at least in theory, is worthwhile. In any event, the objective of liability measurement is relevant in the determination of margins. As long as the measurement objective is based on market participants’ views, risk margins should reflect changes in market participants’ risk aversion as reflected in prices for accepting risks.

Fourthly, the RMWG considered several other characteristics that were not included in the above, because they overlap significantly with the listed criteria. These desirable criteria include (a) transparency, auditability and verifiability (similar to #8), (b) not being over reliant on subjective inputs (related to our assessment of #5), and (c) satisfaction of accounting requirements (similar to #10-#11).

The RMWG also considered the relative merits of new and traditional methods. New methods may have the advantage of including more recent theory and data sources, but may have unidentified flaws. Traditional methods in contrast may have the advantage of being time tested, but might not reflect the most recent concepts and data. We have evaluated the characteristics of each method, as best they can be currently understood, regardless of whether they are new or traditional.

Finally, the RMWG notes that the relative importance of the various characteristics might be different for regulatory reporting than for general purpose financial reporting. For example, characteristic 10, consistency with solvency requirements, is relevant to insurance regulators but not for general purpose financial reporting. Some working group members observe that

market-consistency in practice is more important for general purpose financial reporting than for regulatory reporting. This paper assesses each criterion on its own and does not attempt to assess differences, if any, in the relative importance of the criteria for these two applications. In Section 6.11, this paper assesses each of the risk margin methods identified in Section 6.5 against the IAIS characteristics, RMWG characteristics 1-8, and market-consistency.

6.3 Possible approaches to risk margins

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

1. quantile methods, including
 - a. percentile or confidence levels (VaR);
 - 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 distribution⁴⁴;
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. In addition, there are other possible methods, including those using utility theory⁴⁵ and hazard transforms⁴⁶ that have certain theoretical and/or practical advantages. We do not explore these latter methods further in this report, as they have not been sufficiently investigated to determine how they would apply in this context.

IASB (2007) identified the following approaches that might be used to establish a value for risk margins for general purpose financial reporting⁴⁷, along with which of the above families of methods it belongs in:

- a. confidence levels (VaR) [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 specifically relates to asset values, it has also been used to allocate capital that can affect certain risk margin calculations. In actuarial pricing literature it has been used as a method for

⁴⁴ Moments are considered here for simplification. They include significantly different characteristics compared with quantiles, as they consider the entire shape of the distribution function.

⁴⁵ Buchanan, R.A. (1997)

⁴⁶ Zinkovsky, V. (2007)

⁴⁷ IASB *Discussion Paper* (2007) Part II Appendix F9, page 36-37

determining “cost” in a rate of return method. It appears more appropriate to apply in determining parameters for other methods, rather than as a method itself]

- 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].

Note that IASB (2007) rejected the use of implicit margins produced through an unspecified confidence level or through use of conservative assumptions.⁴⁸

The IAIS identified the quantile (confidence levels specifically) and cost of capital methods as two methods “...among the conceptual approaches currently under consideration in IAIS member jurisdictions to determine the technical provisions...”. The IAIS plans to “...undertake further work analyzing these two approaches, and other approaches that are identified as part of that work.”⁴⁹

The current goal of the IAIS, as expressed in its *Second Liabilities Paper*, is to use the same amount of liabilities for insurance contracts for both regulatory and general purpose financial reporting. Both the IAIS and IASB seem to be moving toward principle-based approaches, 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 seems likely to result in convergence, but that is not guaranteed at the time this paper was prepared.

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 the valuation of the liabilities of insurance companies. These include the use of conservative mortality rates and the selection of less than market discount rates in the valuation of many life and health insurance contracts, while there has been a similar history of purportedly conservative case estimation in general insurance.

Adjustments to the discount rates have sometimes been used explicitly, for example, with specified interest rates for discounting of life insurance and annuities that are less than market interest rates. These have also been used in the valuation of unpaid claim obligations for general insurance (GI, or property and casualty insurance) on an undiscounted basis, with a lack of discounting assumed to approximately offset the lack of an adjustment for risk. Discounting methods used in different contexts have been based on different sets of economic principles, for example, life insurance embedded value calculations that assess future distributable earnings using discount rates that include a risk premium assumed to be at 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

⁴⁸ IASB *Discussion Paper* (2007) Part II Appendix F9, page 36-37

⁴⁹ The IAIS *Common Structure for the Assessment of Insurer Solvency*, February 2007, page 30-31

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 to be a reasonable value.

Further, in general purpose financial reports, some entities choose to use quantiles in the notes to their balance sheets to describe the level of security achieved by the margins actually chosen, even if those margins are determined by another method. This is a required part of disclosure in Australia.

Cost of capital methods have been used for several years in life insurance embedded value calculations. Cost of capital methods are also used as part of the Swiss Solvency Test (SST) and in the pricing of many different kinds of insurance contracts.

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 have produced higher liability values, this has been viewed favourably.

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 using one of the general methodologies listed above. In certain cases, historical assumptions (set at the time the contract was issued) have been used, often perceived to serve as an element of prudence (e.g., by the use of historic mortality rates in the measurement of the liability for term life insurance contracts that does not reflect an expectation for future mortality improvements). Also, risk margins may be calibrated in a second step to eliminate any remaining initial gain which in turn would be allocated to earnings over time in proportion to the process of release from risk.

6.4 Statistical concepts

The key risk concepts needed to understand and evaluate the risk margin approaches include: a risk distribution, normal distribution, standard deviation, coefficient of variation (CV), skewness and the rate at which claim or contract obligations, as applicable, 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 normal distribution is a well known probability distribution. It has a form that requires two parameters, the mean (or probability-weighted average) that 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 expectations depend only on the standard deviation. Thus 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 the sum of any set of homogeneous and uncorrelated risks will approximate the normal distribution as the number of risks increases to infinity.

However, the normal distribution is rarely appropriate to be applied in insurance situations, as there are rarely enough risks involved, individual risks are seldom symmetric and the risks are usually correlated through inflation, mortality, court decisions, etc. The total claim distribution is only similar to “normal” in extremely large portfolios of risks with, at most, partial correlations involved .

- The relative width of a risk distribution can be defined by its CV, 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 CV is 1% in the first case and 200% in the second case.
- Most insurance risks have a high probability of having no claim or contract 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*⁵⁰. They have a parameter that represents the degree of “skewness” (represented by γ , the Greek lower case gamma), that is greater than zero. The normal distribution, because it is symmetric, has zero skewness.

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

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

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 used.

⁵⁰ For large commercial accounts, for example, there will be a significant probability of multiple claims, but the risk distributions will still be skew.

Table 6.1 Assumptions used for risk margin examples

Variable	Sample lines of business			
	Product A	Product B	Product C	Product D
1. γ (gamma)	0.2	0.4	0.8	8
2. Coefficient of variation (CV)	3.0%	13.3%	26.1%	151.3%
3. Settlement pattern	Life – long	GI – medium	GI – longer	GI – medium
4. Increase in ratio of capital to discounted current estimate (p.a.)	0%	10%	10%	10%
5. Notional coverage type	Simple life products	Motor third party liability	“Risky” liability	Catastrophe coverage ⁵¹
6. Risk distribution	NP	NP	NP	LN

Line-by-line notes:

- 1, 2: The skewness and coefficient of variation for the examples are discussed in Appendix C.
- 3: The three payment patterns are shown in Appendix C, Table C.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, for example, 10% per year, 30%, 33%, 36%, 40%... The rationale is discussed in Section 6.5.2, subsection “Release of Capital”.
- 6: NP refers to normal power approximation. LN refers to log normal distribution. The risk distributions for Products A-C are compound poisson 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 C5 compares the NP and LN distributions.

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. In particular, a substantial portion of GI premiums is for business with similar risk characteristics to products B and C (private and commercial property, respectively) but with a short settlement pattern. These short-tail lines, however, contribute a much smaller proportion of liabilities.

Appendix C 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 subsections the first four of the risk margin approaches listed in Section 6.3 are discussed.

⁵¹ Example D relates to unearned exposure plus claims settlement. Examples B and C relate to unpaid claims only. Example A relates to simple life insurance policy obligations.

6.5.1 Quantile approaches

The use of confidence levels is the most common 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, described in Appendix C2) is a modified approach, a mixture of quantile and the mean value of all those cases exceeding the quantile.

Table 6.2 shows confidence level risk margins for the four sample products described in Table 6.1. We illustrate the 65%, 75% and 90% confidence levels because these are levels sometimes considered appropriate for regulatory purposes. We selected CTE levels of 40% and 75% because these produce results that are similar to those for 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 above the mean required to reach selected 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 the distribution. As shown in Table 6.1 in these examples, increasing gamma (skewness) levels correspond to increasing coefficients of variation (standard deviations divided by the mean value)

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

Table 6.3 Risk margins at selected confidence levels
Risk Margin as % 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 comparing the confidence levels, standard deviation and CTE measures of risk margin include the following:

Comparing number of standard deviations to confidence levels

- If the risk distribution is normal, the number of standard deviations to achieve a particular confidence level would be constant.
- As the risk distributions for these contracts are not normal, the number of standard deviations from the mean to achieve a particular level of confidence can decrease as the risk distribution becomes more skewed. For example, Table 6.2 shows that number of standard deviations from the mean to achieve the 65% and 75% confidence levels decreases as the risk distribution becomes more skewed (down the column).
- Conversely, in order to have the risk margin at the same multiple of standard deviation for all contract types, the confidence level would be larger for distributions with more skewness.
- Using a risk margin equal to a fixed number of standard deviations produces positive risk margins, even for highly skew distributions.
- In Table 6.3 for the extreme case, Product D, the risk margin for the 65% confidence level 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, use of confidence levels without some adjustment may not give appropriate risk measures. In Australia, for example, supervisory risk margins for general insurance are based on a 75% confidence level, subject to a minimum of half a standard deviation.

Comparing CTE to confidence levels

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

Comparing CTE to number of standard deviations

- If the standard deviation is considered as a risk measure, the results for the less skew products are consistent with confidence level and CTE. For example, the 75% confidence level corresponds to approximately 0.65 standard deviations above the mean for all but product D.
- However, for the very risky product D, the CTE risk measures require a margin equal to more standard deviations than for the less skew products. The CTE is therefore more risk sensitive than the number of standard deviations, and may be a better risk measure for risks with skewness at the extreme end. Ultimately it can be said that number of standard deviations may be a more consistent measure for expressing profitability, while CTE is more relevant to measure security.

There is no currently generally accepted method for determining an appropriate quantile for the purpose of determining risk margins.

Another method that is in use, based primarily on quantile concepts, applies explicit risk margins for each risk. This approach, which may be most highly developed in Canada, is applied on the basis of professional actuarial standards that specify ranges within which the risk margins must lie. These actuarial standards require the actuary to add an explicit margin for each assumption. For life insurance, that includes a separate margin for each assumption including mortality, morbidity, lapse, expense, and asset default. For non-life insurance the assumptions and risk margins are applied on a portfolio basis.

The minimum level of the Canadian ranges provide for a minimal amount of conservatism, while the maximum is at a level that still is not so conservative as to distort income. Although not explicitly based on a quantitative method, the ranges currently in use have been developed on a practical-tested basis, with the expectation that actuarial judgment will be applied in the context of the actuarial standards. These standards provide a list of questions for the actuary to ask him/herself about the business being valued and provide guidance as to the amount of risk margins that should be used, given the nature of the responses to those questions on a product-specific basis.

The valuation is principles-based, in that the actuary is responsible for choosing the best estimate assumption and the accompanying risk margin. The actuary's opinion confirms that these choices are appropriate for the nature of the business and the entity's circumstances. All assumptions, including the margins and justification for these choices, are reported in detail in a memorandum to the Canadian insurance supervisor and are subject to independent external peer review. The amount of the risk margins is disclosed to the supervisor and may be disclosed in the entity's published financial statements.

It needs to be noted that such approaches, although successfully applied within one country, may be more problematic if expanded internationally. Firstly, underlying risks might deviate from country to country. Consequently, explicit assumption ranges would need to be set separately by jurisdiction without the benefit of a common regulator to monitor consistency. Secondly, the final result of the process might be viewed as the result of negotiation between the insurer and the regulator. In that case, the result is no longer the sole responsibility of the preparer as might be required by IFRS. Finally, international insurance groups are expected to

apply consistent accounting policies throughout the group, so differences, if any, between jurisdictions are problematic.

Variance, semi-variance or higher moment methods are not illustrated here, as there is currently 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 used to set profit margins in premium rates in many markets and, in a simplified form, also used for reporting embedded values for life insurance. It reflects the concept of a risk margin as cost of bearing risk.

To apply the cost of capital method, the applicable capital and cost of capital are needed at the reporting date and at each period of development of the runoff of the obligations. To estimate the required capital amounts, the expected cash flows should be measured at each future reporting period until the claim/contract obligations are settled.

Cost of capital

The cost of capital refers to the amount of return, before income tax, 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 sufficient after payment of income tax.

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%. Alternatively, if corporate income tax were 20%, a pre-tax return of 15% would be required to achieve the 12% after tax return ($.8 * .15 = .12$), and the cost of capital would be 8%.

In this paper 6% is used for most illustrations. 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.⁵²

The RMWG is not proposing that 6% or 4% are appropriate values. Section 6.10.6 further discusses the issues related to selection of the “cost”, although a complete discussion of issues and possible values is outside the scope of this paper.

⁵² To put these rates of return into context, they were suggested towards the end of the bull market that ended in 2008.

Capital

In this method, capital should be determined on an economically sound basis (i.e., sufficiently risk sensitive)⁵³.

A discussion on the detailed methodologies to apply is beyond the scope of this paper. Further discussion of elements of the approach to determine capital that are important in the context of this paper is included in Sections 6.8 through 6.10. More details on approaches to determine capital on an economically sound basis can be found in various papers, including the IAIS *Common Structure Paper* (2007) and the IAA's Solvency Working Party's paper on Solvency Assessment⁵⁴.

Current practice is to determine required capital so that there is a given probability that assets are sufficient to cover the current estimates plus risk margin, that is, the liability, over the selected time horizon. This means the capital is determined as a quantile value.

It is possible that the capital determined by a quantile method does not reflect all the features of the risk distribution that might affect the risk margin. However, that is a difficulty shared by the quantile methods.

Tables 6.4 and 6.5 show the indicated capital using four coverage examples and using five confidence levels for the assessment of the adequacy of capital. These examples assume that the capital is based on a confidence interval approach related to the reporting entity's variability in its claim/contract obligation runoff for a single line of business. The actual context for measuring capital adequacy could include the effects of diversification, of the combination of the reporting entity portfolio with a larger reference portfolio, of operational risks and other issues. Section 6.7 provides more information about the effect of other contexts for measuring capital in this context.

**Table 6.4 Capital at selected confidence levels
Number of standard deviations**

Coverage type	γ (gamma)	Number of standard deviations above the mean required to reach the target 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

⁵³ Also referred to as economic capital.

⁵⁴ IAA *A Global Framework for Insurer Solvency Assessment*(2004)

**Table 6.5 Capital at selected confidence levels
Capital as % 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	7%	8%	11% ⁱ	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 the risk inherent in 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 the rate of default per year. In contrast in the insurance context, the confidence level 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 skewness 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 terms of numbers of standard deviations, is similar for Products A, B and 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).

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/contract obligations declines, although not necessarily in a uniform manner. Although the number of claims/contracts remaining unsettled normally decreases as the runoff progresses, the coefficient of variation and skewness of the distribution of losses or contracts can increase because their risk profile changes during runoff (e.g., the more complex claims that usually have wider and more skewed probability distributions will usually take a longer period to run off).

Moreover, particularly for many lines of general insurance business, the nature of late-settling claims is different from that of early-settled claims. At the reporting date⁵⁵, the later-settling claims are often larger and subject to more disputes and thus experience would be expected to exhibit more variability. Also, later-settling claims are often more subject to uncertain economic effects, for example, inflation, social inflation, and judicial activity, all of which can increase the variability in ultimate payments. On the other hand, for the least mature exposure periods, uncertainty about claims from unexpired risks and unreported claims is high initially and then decreases over time, as more information about these claims becomes available.

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.⁵⁶

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 in this example is 4.5%, the value shown in column 7 of line 1. The 4.5% is the present value of the cost of capital amounts in column 5 over the runoff period (column 3). Appendix C contains further details of the calculation.

⁵⁵As time passes, the uncertainty in the value of these large claims decreases, as more facts become known and as later court rulings clarify the rules that will cover the claim settlements. Nevertheless, the cost of capital method is applied at each reporting date based on the information and level of uncertainty at that date.

⁵⁶SST 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 can be too simplistic. This is an area in which further research is needed.

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

1	2	3	4	5	6	7
Period 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 level⁵⁷ 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%.

Sensitivity tests

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

**Table 6.7 Cost of capital sensitivity tests
Risk Margin as % of discounted current estimate**

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	4.1%	4.2%	25.5%	88.4%

Line-by-line notes:

- 1: The base case uses the assumptions indicated in the note to Table 6.6.
- 2: Illustrates the effect of setting the initial capital to a 99.95% level over a one year time horizon⁵⁸ standard, but using a 4% cost of capital. The increase in capital from a 99.5% to 99.95% level alone increases 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

⁵⁷ Applied over a one-year time horizon; see Section 6.9 for further discussion.

⁵⁸ Applied over a one-year time horizon; see Section 6.9 for further discussion.

- 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.
- 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 similar to the line 1 result for Products A, B and C, with lower skewness. The CTE-based risk margins are higher for Product D, with higher skewness. The result for Product D follows from the higher capital requirements implied by the CTE approach. We believe that, for products with a relatively high degree of skewness, CTE values reflect risk better than those using confidence levels.
 - 4: Illustrates the effect of assuming the ratio of capital to discounted current estimate is constant, rather than increasing 10% per annum as is assumed in the base case, Line 1. For Product A, line 4 = line 1 because the base case for Product A assumed that the capital ratio was constant. There is about a 7% difference between the base case, line 1, and line 4 for Products B and D that are assumed to have the medium GI payment pattern. The difference is much larger for Product C that is assumed to have a long GI settlement pattern. Thus, the rate at which capital is released affects the risk margin more significantly for products with longer settlement periods.

The values shown in Table 6.7 are based on the SST approach. Appendix C3 shows an alternative approach for the cost of capital method.

6.5.3 Discount-related risk margins

Risk adjusted returns

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

One such method assumes that 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. It should be noted that risk margins, under this approach, vary according to the general level of interest rates that in most cases has little to do with insurance risk.

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/contract 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.

There is no currently accepted method for determining the discount adjustment for the purpose of determining risk margins.

Deflators

Deflators, identified in IASB (2007), are usually applied to asset values and are constructed using market price information. There are, currently, no practical examples in the literature on how to apply them to non-hedgeable risks in insurance obligations where there is no relevant market information available.

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 assumed risk-free rate of 4%.

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

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 is 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 arguably has the lowest degree of risk.

6.5.4 Explicit assumptions

There can be different interpretations of the terms *explicit* and *implicit* in this context. IASB (2007) provided an example of an explicit risk margin that might meet its proposed characteristics and several examples of implicit approaches that it did not believe met its proposed characteristics for risk margins.⁵⁹ IASB (2007) did not define explicit risk margins or generally distinguish between implicit and explicit risk margins. However, IASB (2007) indicates that risk margins are to be determined explicitly, rather than being considered implicitly in other components like the discount rates or current estimate.

For the purpose of comparing risk margin methodologies, risk margins are treated as being based on explicit assumptions, if the amount of the margin over the current estimate is specifically calculated, rather than generated implicitly by an unspecified (i.e., not specific to the individual contract) adjustment of discount rates or current estimate. This distinction does not necessarily relate to what should be disclosed. A special case of those risk margins is used here: that referred to by IASB (2007) as explicit, that is, where the margin is determined separately, but without specifically reflecting each of the individual risks separately.

⁵⁹ IASB *Discussion Paper* (2007) Part 2 Appendix F9, pages 36-37

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

Examples of margin approaches 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 has often been applied to general insurance “unearned exposures”.
3. Use an explicit discount rate that is lower than the risk-free discount rate.
4. Use a fixed percentage risk margin assigned by line of business, for example, 5% of discounted current estimate for motor insurance, 10% for riskier liabilities, 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, for example, 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 a financial reporting regime, and to that extent, as currently applied, would be considered implicit assumptions. For example, a common example of an implicit assumption is the use of historical mortality rates for term life insurance, without an explicit mortality trend, thus reflecting an implied risk margin.

More generally, the term “explicit assumption” is sometimes used to describe a set of assumptions used as an approximation for part or all of other methods, for example the quantile or cost of capital approaches.

6.5.5 Qualitative comparison of risk methods – shape and time

With the benefit of this analysis of the four risk margin methods, it may be useful to review the nature of the differences between the methods. The four methods considered two aspects of insurance liabilities to measure risk margins:

- “*time*”: the rate at which risk is released over time; and
- “*shape*”: the risk distribution of possible outcomes around the mean value, at the reporting date, over a specified time horizon.

The different methods consider these sources of risk differently. In their pure forms, the difference between risk margin methods is shown in Table 6.9:

Table 6.9 Source of risks in different risk margin methods

Method	Source of risk used to measure risk margin
Discount methods	Time only
Quantile methods	Shape only ⁶⁰
Cost of Capital	Time and shape
Explicit assumptions	Varies depending on the selected assumptions

We consider this in more detail below.

Discount methods

In a “pure” discount method, every product has the same risk discount adjustment, for example, a 1% risk discount adjustment means we discount at 3% when interest rates are 4%. Thus the method considers only the *time* aspect of risk⁶¹. Moreover, the pure form requires only one parameter⁶², the risk discount adjustment.

In practice, ad hoc adjustments to the risk discount by product may be applied to reflect differences in *shape*. Products with perceived lower risk would have small risk adjustments. Products with higher perceived risk would have larger risk adjustments.

The risk discount approach does not incorporate a theory for constructing risk discount adjustments to cover the range of products in a consistent way. The shape element of risk is generally introduced through ad hoc adjustments that might be aimed at calibration to a target confidence level. In effect, an additional judgmental parameter is required for each type of contract.

Quantile Methods

In the previous sections we applied the term quantile methods to a group of methods that rely only on the *shape* aspect of risk. In the RMWG examples, *shape* was measured variously by confidence levels (VaR or percentiles), conditional tail expectation (CTE) and standard deviations. For each of these *shape* measurement statistics, the method requires one parameter, the confidence level (e.g., 75%), CTE level (e.g., 40%), or number of standard deviations (e.g., 0.6), respectively.

We noted that risk associated with *shape* might alternatively be measured with hazard transforms and utility functions; however, examples of the application of these methods are not given.

Comparing the three quantile methods illustrated in this paper, it is observed that within the range of most contracts the risk margin based on confidence levels does *not* increase with increasing skewness of the product risk distribution. That is a property that might be considered

⁶⁰ Higher moments could be determined per year, consequently reflecting time as well.

⁶¹ The method also assumes that the risk at any time is related to unpaid claim/contract obligations.

⁶² One parameter more than the parameters required to specify the expected settlement time and the risk distribution for the contract.

desirable in a risk margin. In the RMWG examples, the CTE and standard deviation measures did behave as desired in that respect.

Products with longer settlement times tend to have riskier *shapes* than products with shorter settlement *times*, but there is no direct relationship between *time* and risk as measured by the quantile methods. A quantile method will have the same risk margin for a set of obligations that settle over five years as for a set of obligations that settle over two years, if both sets of obligations have the same shape parameter. For example, unpaid claims for a short tail liability product and for excess property product might each have a distribution of settlement amounts described by a log normal distribution with coefficient of variation of, say, 20%. While the property unpaid claims will settle over two years and the liability unpaid claims might settle over five years, both will have the same quantile based risk margins. This assumes the quantile method is applied in the usual fashion. Applying an approach that varies with time would solve that issue.

Cost of Capital

The cost of capital method reflects both *shape* and *time* aspects of risk. The amount of capital reflects the risk distribution of possible outcomes around the mean value at the reporting date over a specified time horizon, that is, the shape component. Moreover, the method considers the rate at which risk is released over time, that is, the time aspect.

Other methods that combine shape and time

As the cost of capital method is only one possible way of combining the shape and time aspects of risk, the following issues might be worth further research:

1. Risk measures for *shape* other than the amount of capital might be used, for example, utility functions or hazard transforms.
2. As the *shape* measure is affected by time to settlement as well as other factors, separating the shape measure into time and non-time components might allow better determination of risk release over time.
3. Decomposing the risk margin into its time element and the separate time and non-time components of shape might allow a comparison with financial products, to provide insights into market sensitive treatment of parameters.
4. The time element of risk might not be a constant cost per year as it is in the cost of capital method.
5. There may be other ways to combine *shape* and *time* elements of risk that might be better, for some purposes, than the cost of capital formulation.

For now, as the cost of capital method uses only two parameters and is a framework that is in many jurisdictions relatively familiar as a pricing approach for insurance contracts, the cost of capital method might be described as the simplest risk margin method that explicitly reflects both shape and time.

6.6 Quantitative comparison of methods

Table 6.10 below compares the examples from the methods described in Section 6.5.

Table 6.10 Comparison of risk margins from different methodologies
Risk margin as % of discounted current estimate

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 product	Simple life products	Motor 3 rd party liability	“Risky” liability	Catastrophe coverage

The following are observations from Table 6.10:

- 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, 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 have a risk margin similar to that of the 75% confidence level. An effective discount rate of less than 2% (i.e., a 4% interest rate with a risk adjustment of somewhat more 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.

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

6.7.1 Pooling and diversification

Generally, viewed from the bottom-up, pooling of similar risks in portfolios or diversification by combining portfolios that are sufficiently uncorrelated reduces risk and, therefore, should 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 margin is reduced by allowance for pooling and diversification.

The extent that pooling and diversification are reflected in international financial reporting systems has not been determined at the time this paper was written. Risk margins might be based on several combinations, including (1) the entity's own size but separately by line of business, that is, no inter-portfolio diversification, (2) the entity's own size and diversification by line, (3) the entity's group pool size and diversification, (4) 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 (5) the pooling and diversification available to a real or hypothetical acquirer of the portfolio locally or globally. We assume this will be resolved when the accounting measurement objective of the applicable reporting standards is determined.

In contrast, viewed from the top-down, an insurer's entire capital is available to support all of its risks, and its overall capital is, therefore, a function of its total risk profile, as modified by any ceded reinsurance. From this point of view, the cost of capital that matters is the cost of the entity's total capital and the probability distribution that matters most under quantile approaches is the probability distribution of total net claim costs. Once the total risk margin is determined, an allocation of the capital is required, if risk margins are needed for subdivisions of the total liability.

While these two approaches are equivalent, the top-down approach makes it clear that diversification and reinsurance are both integral to the determination of risk margins and not an optional add-on.

Section 7 and Appendix E discuss pooling and diversification further.

6.7.2 Reference portfolio/entity concept

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

The IAIS has proposed that “similar obligations with similar risk profiles should result in similar liabilities”⁶³, even when the obligations are in different entities. To achieve the IAIS objective using risk distributions, for example, by means of 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 that includes 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) would record different liabilities; the entity with risks X and Y would measure a smaller risk margin per unit of risk X than would the entity with only risk X.

One way to achieve the IAIS objective would be to determine 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's liabilities on the basis 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, diversification and ceded reinsurance, based on the circumstances of the industry in the jurisdiction (or even a part of it) to which the entity is subject. In this way, the risk margin for the reporting entity (in case of a consolidated group determined, perhaps, on the basis of each 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 and with reinsurance appropriate for its size. In this case,

1. *Large* means large enough that *process risk*, the random fluctuation around the expected value unavoidably present in each stochastic process (this can also be referred to as *random deviation risk*), is as small as observably achievable in the respective industry of the applicable market (local or global).

For many types of insurance, given that the reference entity is large, the process risk would be negligible compared to parameter and model risk that is, the additional variability in outcomes that occurs because the process is not fully understood or there is a significant uncertainty regarding the appropriate mean values or other parameters.

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

2. *Multi-line, diversified* means that the insurer's total risk distribution reflects all the realistically achievable benefits of risk diversification, across portfolios and territories,

⁶³ IAIS, *Second Liabilities Paper* (2006), Executive Summary, page 2

that 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. This includes diversification 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.

3. *Business similar in nature* means that determination of the characteristics of the reference entity is based on a review of a set of similar entities 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 the assumed financial strength of the hypothetical transferee insurer and the cost of capital are developed on a consistent basis, the effect on risk margins may not be significant.
5. Reinsurance enables an insurer to extend its pooling and diversification outside itself. While there is some individual variation, the general pattern is that larger insurers make less use of reinsurance than do smaller ones. As a result, variation in the degree of pooling and diversification, including pooling and diversification through reinsurance, is much less than it would be in the absence of reinsurance. Looked at in another way, reinsurance reduces an insurer's need for additional capital. Instead, it can, in effect, rent off-balance-sheet capital from the reinsurer. Again, capital requirements, as a multiple of net liabilities, vary less by size of insurer than would be the case without reinsurance.

As use of a reference entity that cannot be observed is a relatively new concept, it may be difficult to apply in a consistent manner 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 to achieve (and perhaps not possible). Other working group members believe that the actuarial or accounting standard setter or regulator could provide sufficient guidance to make this approach 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 through 6.6 assume that all relevant risks were included in the risk distributions. This applies whether risk is measured from the perspective of the reporting entity/portfolio or the perspective of the reference entity/portfolio.

For the current discussion of risk margins⁶⁴, risks reflected in the risk distribution are all the non-hedgeable⁶⁵ risks associated with the runoff of claims/contract obligations, including the risk of variability in the amount of settlement obligations, reinsurance credit risk⁶⁶, and operational risk (for further discussion, see Section 8.4), but not including market or credit risk for assets, as far as those are hedgeable. Table 6.11 summarizes some of the typically observed risks in an insurance contract and identifies which are to be included in the risk distributions considered in the measurement of risk margins.

The indications in Table 6.11 are not intended to be true in every case, nor are they complete, as the actual risks to be included and modelled will depend on the extent to which the entity's risks can be hedged. Risks that are not completely hedgeable need to be considered in risk margins. For example, these may include market and currency risk in thinly traded markets, such as those in developing economies.

Table 6.11 Summary of risks reflected in the risk margin

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 and 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 and uncertainty*	Yes

⁶⁴ IAIS *Structures Paper* (2007), Ruygt (2006), CFO Forum (March 2006), and the SST methodology.

⁶⁵ To avoid doubt as what is hedgeable, as noted earlier a risk is hedgeable if there exists an active market in which it can be traded. The hedgeability derives from the existence of the market and not directly from the characteristics of the risk.

⁶⁶ 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.

Business Type	Risk type	Included?
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**	Yes
All	Credit	No
All	Market	
All	Interest Rate	No
All	Currency	No
All	Real Estate	No
All	Equity	No

*Including risks from inflation, timing of loss payments, changes to the legal system, etc.
**Operational risk applicable to the liability runoff that is, liabilities and assets related to those liabilities.

This context for consideration of risk types involves several assumptions, including the following:

1. In risk margins as applied up to now, for example in Australia for general insurance regulatory reporting and less formally in other jurisdictions, the risk distributions used relate to claim/contract obligations and do not consider operational risk or reinsurance credit risks. That is a choice made by the applicable regulators, not a necessary characteristic of a specific measurement approach. In the discussion in this paper it is assumed that all methods considered would be applied to risk distributions that reflect all of the risks described above.
2. This approach to the measurement of risk margins assumes the risk-free rate is used for discounting (see Section 5 for further discussion of discounting). If an insurer selected a higher discount rate then to be consistent the risk distribution used to calculate quantiles or capital amounts used in risk margin methods would indicate larger risk margins to reflect the additional asset risk. This alternative approach would likely indicate a higher total liability.⁶⁷

⁶⁷ This paper does not attempt to prove this assertion, but the RMWG believes it is plausible. We assume that any diversification benefit between assets and liabilities is either considered elsewhere or is not allowed. The increase in the return from riskier assets would reflect the “normal” return situation. The increase in capital, however, would reflect adverse returns with a likelihood of 1/200 or less. We expect the increase in capital would normally more than offset the increase in return.

3. Insurers often fail to hedge some or all hedgeable risks, often to avoid the cost of the hedge or through lack of recognition of the risk. The increased risk resulting from that decision needs to be reflected in the total balance sheet approach for ongoing operations, and therefore in regulatory and economic capital. However, the additional risk should not be reflected in risk margin measurement, as any market participant can avoid this deliberate mismatch.
4. 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 discussed the combination of risks with respect to combining numbers of risks and different lines of business. Appendix E discusses issues related to combining the different types of risks identified in Table 6.11.

6.9 Context for risk margins – time horizon and risk perception

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

In the *IAIS Common Structure for the Assessment of insurer Solvency* (2007), 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.⁶⁸

This suggests two possible approaches:

1. The time horizon for the risk margin relates to the full runoff of contract 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 a specific time period (e.g., one year) and the amount of capital is calculated by estimating the change in capital (market value of assets minus market value of liabilities) with a specific percentage of probability (e.g., 99.5% as in the European Solvency II project) of assets being sufficient to cover the liabilities needed one year from the reporting date (Change in Capital Test).

The Change in Capital test requires an estimate at the reporting date of the distribution of possible changes in risk perception between the reporting date and the end of the time horizon. The measurement of liabilities for insurance contracts should consider 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. If done on that basis, the two methods will produce similar results.

This relationship between the capital, and therefore risk margin, required based on the Runoff test and the Change in Capital test warrants further study. This requires an understanding of the distribution of changes in risk perception. Estimating future changes (as distinct from

⁶⁸ IAIS, *The IAIS Common Structure for the Assessment of insurer Solvency*, Structure element 11 and discussion following, page 27-28, February 2007.

observed historical changes) represents a complex and broad issue that should be considered in a future update of the IAA *Blue Book* or another solvency-related paper.

Further discussion of the topic of risk distributions in the context of time horizon and change in risk perception is included in Appendix C5.

6.10 Practical issues and partial solutions

This section discusses several of the practical issues associated with various risk margin approaches. In some cases it discusses possible strategies to address these issues. The applicability of such strategies generally depends on an evaluation of whether they are in conformity with the applicable reporting standards. Especially for general purpose accounting, such strategies may be part of the accounting policy of the entity and subject to the judgment of the actuary preparing the measurement.

6.10.1 A possible simplified approach to reflect diversification and pooling – defining the reference entity

Section 6.7 discussed the use of a reference entity. With respect to that issue, one approach, using aspects of both 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. However, it would neither fully achieve the IAIS objective, nor describe the actual situation of the specific entity.

This is summarized in Table 6.12.

Table 6.12 Risk context options

Basis of calculations	Liabilities similar across entities?
Use reporting entity	No
Use scaled up entity	Yes, if diversification is not to be reflected No, if diversification should be reflected
Use standardized reference entity	Yes

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

6.10.2 Calibration and consistency

Each risk margin method requires parameters that need to be selected using a combination of judgment and data. These areas include:

- cost and capital level 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; and
- selection of values for explicit assumptions.

With respect to these parameters,

- For all approaches, the calibration to market-based values (i.e., actual transfer values) is problematic, as there are few, if any, 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 accumulations of transferred business that it is not possible to derive prices for specific relevant parts.
- Disclosure of, or regulatory or professional guidance regarding, methods and the resulting margins will tend to produce consistency between entities over time.
- If any of the risk margin methods becomes a basis for transfers in the future, data may make calibration more reliable over time.

6.10.3 Reliance on models

The use of cost of capital or quantile methods requires more sophisticated modelling than explicit assumption methods.

Quantile methods require models to determine the risk distributions, so that the amount of assets required to achieve the desired level of confidence in meeting contractual obligations can be determined. Multiples of higher moments, which consider the entire shape of the distribution, require that the shape of the entire distribution function be estimated or model-based estimators used. The cost of capital method requires models to measure the capital in a manner that is on an economically sound basis (i.e., sufficiently risk sensitive).

Equity, reported capital and regulatory capital may be available from existing financial reports. However, that information is not appropriate for direct use in the cost of capital method. Regulatory capital and reported capital relate to all of the entity's risks and strategic choices.⁶⁹ 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 the ongoing entity. Even information on capital from runoff 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. Further, at a given time, available capital is typically either too high or too low compared to economic capital, since economic capital is a moving target and also an unobservable theoretical concept.

As some insurers may not be able to construct the models needed, they may have to utilize benchmark or other proxy information to apply the risk margin methods. For regulatory reporting, known benchmarks are those in Standard Capital Requirement (SCR) being

⁶⁹ Hitchcox, pages 6-7

discussed in the context of Solvency II.^{70,71} For percentile purposes in Australia, there are published capital benchmark factors, representing the target confidence levels that entities can consider. In Canada, a set of explicit assumptions has been developed to approximate target confidence levels. These benchmarks act as explicit assumptions, supporting a cost of capital or quantile methodology.

Entities and regulators are increasingly relying on models to measure risk.

In addition:

- Rating agencies consider entities' internal models in their assessments. Also, some rating agencies are in the process of starting reviews of company models. For example, Standard & Poor's has issued a paper on the assessment of internal models used by entities rated by S&P.
- The IAIS has developed a principles-based paper on internal models (June 2008).
- The IAA's Subcommittee on Solvency, at the request of the IAIS, is at the time this paper was written developing a paper on the assessment of internal models, with a draft (January 2009) issued prior to its public exposure.
- The CRO Forum has undertaken a benchmarking study of its members, providing information on a framework for increasing consistency in modelling (CRO Forum (2009). This study is a follow-up to a previous survey conducted in 2006 (a joint survey with the International Financial Risk Institute) and to a benchmark study published in 2005).

6.10.4 Sources of risk distributions/treatment of extreme events

The examples shown earlier in Section 6 are based on theoretical distributions. In practice, risk distributions may be partly based on methods including curve fitting and stochastic modelling.

One difficulty with these techniques is that there is usually insufficient, or no, information on the effect of extreme events. Some approaches to address this issue include the use of:

- 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 claims or underwriting systems or procedures).

Moreover, the examples assume that estimates of the probabilities of all outcomes are available. 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

⁷⁰ Solvency II attempts to construct models that separately evaluate the different risks on a line by line basis. Other regulatory capital schemes do not operate 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.

⁷¹ This assumes that "capital" for the cost of capital method is the SCR level and not at the higher level at which that most companies normally operate. As a practical approach, it may be possible to adopt a common multiple of the SCR level, as an approximation to economic capital.

complete risk distribution. Also, it may be sufficient to have the severity of events only at specified probability levels. Stress and scenario testing might be used to provide information on the events at the required levels of probability.

Moreover, the risk distribution needs to include provision for the effect that the underlying model is wrong in some respects, to comply with margin characteristic 6.1.3. For example, in estimating expected property insurance outcomes, the assumption that extreme weather conditions are becoming more common may be correct. There are some techniques for addressing such risks, but this area remains a matter of ongoing research.⁷²

Nonetheless, the degree of potential unreliability of models, particularly for extreme events, even with the mitigation strategies noted above, remains significant,⁷³ as quantifying this risk can be complicated.

Professional judgment, regulatory, accounting or professional guidance may be required to determine the appropriate approach.

6.10.5 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 relates directly to transfer values.
2. As shown in the examples, it might be appropriate to use different confidence levels for different products. Note that an appropriate methodology to develop a specific level of overall confidence has not yet been developed and it is unclear whether it can exist; varying the levels chosen by product emphasizes this difficulty. In addition, having different confidence levels by product may make it more difficult to achieve (global) consistency.
3. During the course of claim runoff, the risk distribution may become wider and increasingly skewed, that is, there are fewer claims and the remaining claims may be larger. As a result, as with differences by product, different confidence intervals by claim runoff year may be necessary to maintain a consistent risk margin for a growing or declining portfolio⁷⁴.
4. Similarly, for life products, the distribution of risk by age or contract duration may change and hence confidence levels may need to change over time.

While different confidence levels may be required for different products and years at different levels of maturity, a constant CTE level might better achieve the desired simplicity. Therefore, issues two, three and four above may be partially resolved by the use of CTE rather than confidence level targets.

⁷² Non-technical readings on this subject include Taleb (2007) and Rebonato (2008) for popular descriptions of the issue.

⁷³ The RMWG notes that while this statement may be reasonable, risk assessment is nevertheless needed to manage the business and provide for an adequate level of solvency.

⁷⁴ Assuming that, for the reasons described earlier, a constant confidence level does not reflect constant risk for purposes of setting risk margins.

6.10.6 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, that is, the return as required by market participants, where possible by market observations such as in prices for related instruments.

In practice, differences in the cost of capital based on the financial rating of the entity may not greatly affect the risk margin if the capital level for the reference entity and the cost of capital level are selected on a consistent basis. For example, Table 6.7 in Section 6.5.2 shows that in the selected examples, the risk margin is not significantly changed (with the partial exception of the highly skewed Product D) because the reduction in the cost of capital assumed for a more highly rated insurer is largely offset by the increase in capital required to become more highly rated.

The cost of capital for the cost of capital method is the before-the-event target intended to produce an investor’s target return.

The cost of capital does not refer to the firm's cost of capital, but rather to the relevant (e.g., a reference entity's or capital market participants') market's requirement for return on the capital needed for the non-hedgeable 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 is usually what commentators have in mind when discussing a market-based approach in a cost of capital analysis. Two issues regarding this source are evident. First, what is the cost of capital required by external market participants 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 its market value?

There are several well-known methods for establishing the first value, the market cost of capital, with the Capital Asset Pricing Model (CAPM) perhaps being 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.⁷⁵

However, these methods are not designed to be applied to non-hedgeable risks. Moreover, the results of these different methods can, and often do, produce different values of cost of capital from the same set of data.

The market-consistent cost of capital then needs to be converted into the investor's expected return on market value and into an internal return on capital for the

⁷⁵ Cummins, J.D. and Phillips, R.D. (2005)

reference entity. This issue is discussed in depth in Hitchcox (2006) and Swiss Re (2005). As with the cost of capital analysis, results can vary.

4. The CRO Forum's *Market Value of Liabilities for Insurance Firms - Implementing elements for Solvency II* (2008) includes an analysis aimed at establishing the “cost” in the cost of capital method.

CRO Forum (2008) does not contain a recommendation about the proper level of cost. Rather, its examples are for illustrative purpose only, using costs that have been used by others for this purpose. Among its observations regarding the cost of capital:

1. Sources of information about the appropriate level for the cost of capital include business judgment, history of returns on book value, and market analysis.
2. The cost of capital for application in the risk margin method is not the same as the after-tax return on market value that is sometimes determined from methods such as CAPM. This is because the market cost of capital must be adjusted to produce values applicable to the cost of capital method that does not reflect the firm's cost of capital and its franchise value (market value minus reported capital in the financial statement, including the value associated with future books of business).

Recent literature on the market cost of capital, including converting it into a 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.

3. Whatever the standard for determining cost of capital for a particular insurance entity, the appropriate method of converting that to one for a reference entity used for modelling the risk margin for financial reporting purposes 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 is important to consider that the cost of capital may vary by product and risk.

6.10.7 Capital in the cost of capital method

In Section 6.7 we showed that if capital levels and cost of capital are selected on a consistent basis, then varying the capital level may not significantly affect the risk margin. However, to ensure appropriate treatment of capital levels and associated cost of capital rates, the selection of capital levels needs to be clear about the following issues,

- Is the capital used in the cost of capital method based on the regulatory capital, economic capital or some other standard?
- If the capital is based on a multiple of regulatory capital, since regulators have standard formulas and also allow internal models, would risk margins be based on the capital determined from the standard formula or the internal model?

- To the extent that international convergence is incomplete, if entities and groups are regulated by different regulators or are listed in different countries, how would differences in capital standards by country be considered?

6.10.8 Definition of solvency for capital modelling in the cost of capital method

Some working group members have observed that current actuarial practice for capital modeling includes two different approaches used to assess the adequacy of total financial resources as follows:

- 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; and
- 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 C3, the application of these approaches produces somewhat different amounts and patterns of risk margins. Method (b) can produce a lower risk margin because it includes capital to protect expected settlement values in addition to the expected cash flows plus risk margin. Method (a) is consistent with the IAIS Common Structure (2007) guidelines (Structure Element 8, page 25).

Although capital assessment is not the focus of this paper, it is a key element in the cost of capital approach. Regulatory or professional guidance may be required to ensure consistency of results in the measurement of liabilities by this approach.

6.11 A qualitative comparison of various risk margin methods

This section compares the various risk margin approaches described in this paper against the desirable characteristics identified in Section 6.2.

The comparisons are based on the approaches as they are defined, without simplification or approximation. At the end of this section, how simplifications and approximations might affect the comparison of the methods is discussed.

The tests are considered one at a time. In each section below, we discuss the relative strengths and weaknesses of each of the methods, relative to that desirable characteristic. To summarize this discussion we rank the methods, based on the discussion in Section 6.11.7⁷⁶.

It is beyond the scope and not the intent of this paper to select a single method. Therefore there is no attempt to rate the characteristics more precisely than shown here. In interpreting the ranking the following should be considered:

⁷⁶ In this discussion and ranking we considered the methods as they might apply without detailed tailoring to products or jurisdictions. The methods might be tailored to fit particular contexts, and in that context perform better than indicated by the rankings.

1. There is no attempt to quantify whether the difference between 1 (best) and 2 is large or small. The difference may be large in some cases and small in other cases.
2. Relative weights applicable to various characteristics are not given.
3. The ranking is not unique or universal, as some of the ranking is subjective and is based on the personal experience of the authors with the methods, and does not relate to the merits of the theoretical underpinnings of the methods.
4. The ranking is not intended to indicate that one method is better than another in all circumstances. Variations in products, business context, and the like may make some methods better than other methods in different circumstances.

6.11.1 Compliance with the five IAIS characteristics

The five characteristics identified by the IAIS, from Section 6.2, 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."

The RMWG notes that there are two possible interpretations of characteristic c. One interpretation is:

Liabilities that persist over a longer timeframe have increased exposure to risks, and hence will have higher risk margins, than shorter tail liabilities that are otherwise exposed to similar risks. We call this c-1.

Another interpretation is:

For two sets of liabilities with the same riskiness in their distribution of ultimate settlement values (i.e., having similar risks) the risk margin should be higher for the liabilities that settle over a longer time period. We call this c-2.

For example, unpaid claims for short tail liability coverage and for excess property coverage might each have a distribution of settlement amounts described by a log normal distribution with coefficient of variation of, say 20%. The property unpaid claims will settle in, say 2 years. The liability unpaid claims might settle in, say, 5 years.

From a cost of capital perspective, the risk margin would be higher for the liability coverage because the capital to support to the risk must be held for a longer time period. From a

discounting perspective the risk margin would be larger for the liability coverage because the settlement time is longer.⁷⁷

From a quantile perspective the two sets of unpaid claims would have the same risk margin.

We individually assess each of the methods in Section 6.5 against these characteristics, which we refer to as the six extended IAIS characteristics, including both c-1 and c-2.

Cost of Capital method

Normally, the cost of capital method would satisfy all six extended IAIS characteristics if the chosen capital is determined on an economically sound basis (i.e., sufficiently risk sensitive). Characteristics (a) - (e) require that the risk margin increase as the risk distribution becomes wider or more skewed. Section 6.5 shows that this is the case for the cost of capital method. Characteristic (c-2) 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.

Quantile methods

All of the quantile methods⁷⁸ fail characteristic (c-2). Consider two products that have the same risk distribution for unsettled contract obligations at the reporting date, but have obligations that involve settlement over two different time periods. To comply with characteristic (c-2) the margins should be different. However, the risk margins for the two products based on confidence level, CTE, number of standard deviations, or any method that relies only on characteristics of the risk distribution, would not be different.

Quantile methods – confidence level methods

In addition, the confidence level method does not necessarily satisfy characteristics (a), (b), (d) or (e). In Section 6.5 we showed that highly skewed distributions, for example, 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 characteristics (a), (b), (d) and (e) throughout and the letter of those in the extreme.

Quantile methods – CTE and standard deviations methods

CTE and methods based on multiples of the standard deviation generally satisfy characteristics (a), (b), (d) and (e) better than do 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 refined, in that it can provide a better insight into the tail amounts, its general approach is similar to that of confidence levels.

⁷⁷ Unless different risk discount adjustments were applied to the two coverages.

⁷⁸ Some working party members believe that quantile methods could be refined to address the issues better. This assessment is based on quantile methods as they are now most often applied.

Discount methods

Discount methods, other than the one that uses a zero discount, satisfy characteristics c-1 and c-2. The methods satisfy the other characteristics only if that interest rate risk adjustments vary by product and settlement duration. Discount methods have not been applied in that way in the past.

The use of a zero discount does not routinely satisfy characteristics c-1 or c-2 because changes in risk-free rate, with no change in uncertainty, would cause a change in the risk margin implied by use of a zero discount.

Explicit or implicit assumptions

Although explicit or implicit assumptions could be constructed in a manner to address the characteristics, they do not necessarily satisfy any of the characteristics. Each product would need its own set of assumptions.

As an implementation approach, explicit assumptions, selected by product, could be made to approximate the percentile, cost of capital or discount methods. If the approximation was sufficiently close, the explicit assumption approach would satisfy the characteristics to the same extent as the method it approximates.

Summary

While each of the methods could be adjusted to better fit the characteristics, a comparison of the methods if applied in a straightforward manner across multiple products is summarized in Table 6.13.

**Table 6.13 Comparison of risk margin methods
Compliance with the five IAIS characteristics**

Issues	Cost of capital**	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Complies with IAIS characteristics (a), (b), (c-1), (d), (e)	1	1	2	3	4*
Complies with IAIS characteristic (c-2)	1	3	3	2	4*
Overall	1	2	2	3	4*

1=best; 4=worst;

*As implementation method, explicit assumption ranking would be close to the target method; on stand-alone basis, it cannot be assessed and therefore is ranked 4th.

** It is assumed that the capital is determined on an economically sound (i.e., sufficiently risk sensitive). If more simplistic methods are used, the rating might be worse.

6.11.2 Compliance with RMWG desirable characteristics 1-3

The first two characteristics 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.

3. Be determined in a manner consistent with sound insurance pricing practices;

The cost of capital method, under various names, is also a common actuarial pricing methodology in some markets⁷⁹.

Some quantile methods, particularly standard deviations methods are also used in insurance pricing, although less frequently than cost of capital methods.

Risk adjusted discount rates have also been used in pricing insurance products that have features that directly relate to financial markets, for example, financial guarantees or deposits. These approaches are less relevant to non-hedgeable aspects of other insurance risks.

**Table 6.14 Comparison of risk margin methods
Compliance with additional RMWG characteristics 1-3**

Issues	Cost of capital	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Complies with additional RMWG characteristics (1), (2)	1	1	1	1	1*
Complies with additional RMWG characteristics (3)	1	2**	2	3	4*
Overall	1	2**	2	3	4*

1=best; 4=worst

*Rank shown is on a stand-alone basis. As an implementation method, the ranking of explicit assumptions would be close to the target method. On a stand-alone basis, to the extent it cannot be assessed it is ranked 4th.

**Standard deviation method has this characteristic more completely than confidence level methods.

6.11.3 Consistency among classes of business – RMWG desirable characteristic 4

For the purpose of this assessment, consistency means the extent to which a risk margin method generates values across classes of insurance contracts in accordance with the six extended IAIS characteristics regarding risk distributions. Any method, given enough

⁷⁹ Hart, Buchanan and Howe (2007)

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 comply with the six extended IAIS characteristics.

As discussed previously in Section 6.11, the results of the application of confidence level methods do not behave as desired according to the IAIS guidelines when applied to products with different risk distributions. The confidence level in the confidence level method would need to vary between products to reflect the targeted degree of consistency. However, both the CTE and multiples of standard deviation methods can provide consistency between products.

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 6.15 Comparison of risk margin methods
Consistency between classes of business**

Issues	Cost of capital	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Consistency across classes of business	1	2	3	3	4*

1=best; 4=worst

*Rank shown is on a stand-alone basis. As implementation method, explicit assumption ranking would be close to the target method.

6.11.4 Ease of calculation – RMWG desirable characteristic 5

In our discussion of the ease of use of a calculation benchmark, we consider the mechanical application of formulas or the use of models that requires no judgmental inputs as “easier” than methods that require judgment in addition to calculations. Methods that require less simulation of future results are also characterized as easier than methods that require more extensive simulation of future results.

Cost of Capital

At each reporting date we need to determine the applicable capital levels both at the reporting date 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 the “cost” in the cost of capital method are not yet well established. It would be easy if the cost, for regulatory financial reporting purposes, was determined by regulation, as in 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 judgment. In addition, if the “cost” in the cost of capital method for regulatory financial reporting is specified by the regulator in a way that is not consistent with what the market would require, then the value might not be suitable for general purpose financial reporting.

Quantile

In the family of quantile methods, at each reporting date an estimate of the quantile or moment information is needed only at that reporting date. The release of risk over time is not considered in the quantile method in its traditional form. 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 confidence levels to reflect the risk in each period adequately.

As discussed in Section 6.10.4, the standard deviation and CTE methods require information about the extreme tails of the distributions, and that requirement might mean that the calculation is more difficult, as it requires more judgment or analysis than is required to determine confidence levels.

However, if the approaches are adjusted to cope with all the IAIS characteristics, they might result in a similar level of complexity, as compared with the cost of capital approach.

Discount

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

Explicit Assumptions

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

If explicit assumptions were used as an implementation approach, then periodically the assumptions should be tested to confirm that the approximation remains valid. This testing would be particularly important if environmental changes (e.g., interest, inflation, equity markets, and court decisions) are likely to affect the validity of the approximation. This testing requirement, particularly during times of environmental change, reduces the ease of calculation of explicit assumptions.

The discussion above is summarized in Table 6.16.

**Table 6.16 Comparison of risk margin methods
Ease of Calculation**

Issues	Cost of capital	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Ease of calculation	4	3	3*	2	1**

1=best; 4=worst

*Among quantile methods, confidence level risk margins can be easier to determine than CTE or standard deviation risk margins. Although the development of ranges, standards and application judgment in methods like that used in Canada can be onerous, the actual calculation to apply them can be relatively easy.

**Rank shown is on a stand-alone basis. As implementation method, explicit assumption ranking would be closer to the target method ranking.

6.11.5 RMWG desirable characteristics 6 - 8

Characteristics 6 and 7 are the following:

6. Is consistently determined between reporting periods for each entity, that is, the risk margin varies from period to period only to the extent that there are real changes in risk;
7. Is consistently determined between entities at each reporting date, that is, two entities with similar business should produce similar risk margins using the methodology;

These characteristics depend on whether the risk margin method is properly sensitive to risk, the six extended IAIS characteristics and RMWG characteristic 4, and also sufficiently easy to implement, RMWG characteristic 5. Since the evaluation overlaps with the characteristics already discussed, we have not separately rated these two characteristics.

Characteristic 8 is as follows:

8. 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 level of 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.

6.11.6 Market-consistency⁸⁰

To the extent that market-consistency is required as a principle guiding the measurement or as a tool to enhance consistency based on an external benchmark, the following are relevant from a theoretical perspective:

⁸⁰ Note the discussion on market-consistency in practice and market consistency in theory in Section 6.2.

- The cost of capital approach measures risk (expressed as an amount of 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.
- Some quantile methods, particularly standard deviations methods, and less frequently risk adjusted discount rates, are used in risk assessment, but not typically for pricing, outside of insurance.
- The cost of capital method attempts to utilize market information, for example, required returns, while the other methods have no specific connection to market information.

However, none of the approaches solve the issue that there may not be information about how market participants assess the risk to be measured.

There is no available information that allows us to determine whether a particular calibration actually produces transfer values, although in some cases the application of common or generally accepted methods may result in values close to being market-consistent. We therefore split our assessment of these characteristics, between theory and practice, as follows:

**Table 6.17 Comparison of risk margin methods
Market-consistency**

Issues	Cost of capital	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Market-consistent in theory	1**	2	3	4	4*
Market-consistent in practice	Unknown	Unknown	Unknown	Unknown	Unknown

1=best; 4=worst

*Rank shown is on stand-alone basis. As an implementation method, explicit assumption ranking would be close to the target method.

**It is assumed that the capital is determined on an economically sound (i.e., sufficiently risk sensitive). If more simplistic methods are used, the rating might be worse.

6.11.7 Summary

To the extent we considered practical, Table 6.18 summarizes the prior discussion by ranking how the methods could achieve the objectives, with

(1) = best meets the characteristics and (4) = least meets the characteristics.

Table 6.18 Comparison of risk margin methods

Issues	Cost of capital	Quantile methods		Discount	Explicit assumptions
		CTE & std dev	Confidence level		
Complies with five (or six) IAIS desirable characteristics	1	2	2	3	4*
Complies with additional RMWG 1-3	1	2**	2	3	4*

Consistency across classes of business-5	1	2	3	3	4*
Ease of calculation-4	4	3	3***	2	1*
Disclosure-8	1	1	1	1	1
Market-consistent - in theory	1	2	3	4	4*
Market-consistent - in practice	unknown	unknown	unknown	unknown	unknown

1=best; 4=worst

*Rank shown is on a stand-alone basis. As implementation method, explicit assumption ranking would be close to the target method.

**Standard deviation method is more often used in pricing than confidence levels.

***Among quantile methods, confidence level risk margins might be easier to determine than CTE or standard deviation risk margins.

The rankings given in Table 6.18 are based on an implementation of each of the methods as described in Section 6.5. It assumes, for example, the cost of capital method is applied to a capital measurement that is sufficiently risk sensitive.

The rankings in the table might 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 would be easier to implement with a standard capital model and a formulaic method of releasing capital over time. However, such simplifications would be likely to reduce its risk sensitivity and/or market sensitivity. The explicit assumption and discount methods might be made more risk sensitive or market-consistent by calibration to cost of capital or quantile results by product, although it is not practical to rank all the permutations of approaches. A decision about what method is appropriate will need to consider the type of simplifications that are appropriate for the reporting purposes.

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 skewed risk distributions. To the extent that confidence levels are specified for risk margins or capital measurement in the cost of capital method, these can better represent appropriate 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 purely 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 usually 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 of the methods to be tested for market-consistency on an overall basis. Some approaches, like moments, reflect superior theoretical concepts as to how market participants price risks (utility functions) than, for example, confidence level methods, reflecting security (extreme event) perspectives.

Some RMWG members believe that, on balance, the cost of capital approach would be preferable from a pragmatic viewpoint, 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 be preferred at this time, since any gain in relevance achieved by the cost of capital method does not outweigh calibration uncertainties, the cost of capital 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. As a result we did not explore them further in this paper.

7. Risk Mitigation Techniques

7.1 Introduction

Risk management and risk mitigation are very significant functions in the management of any insurance company. A risk mitigation technique is an action by the insurer in the management of the risks associated with a set of insurance contracts or the methods used to manage the insurance entity to reduce the expected cash flows or the uncertainty associated with those cash flows. Although expected cash flows are affected by the type and extent of their resulting effects, most of the discussion in this section relate to their effect on risk margins. To a great extent, the effective application of risk mitigation techniques reduces the level of uncertainty associated with the expected cash flows under insurance contracts and thus reduces the aggregate cost of bearing these risks.

A general principle applicable to the analysis of these techniques is that the effect of a mitigation technique should be reflected in the current estimate and risk margins of insurance contracts only to the extent that it is expected to affect the current estimate of directly related cash flows of the portfolio of insurance contracts or their uncertainty, rather than the cash flows associated with the operation of the entity (see Section 3.3.7). In some market-consistent frameworks, if the effect of the technique is potentially observable within the unit of measurement (the portfolio), for example, through market prices, it would be reflected in the liability. For example, for risk diversification across portfolios, it would only be reflected to the extent that its effect would be either observable in a market or it is assumed that if there was a relevant market it would be reflected in prices in that market.

In paragraphs 30 – 33 of the IAIS *Second Liabilities Paper* (2006), 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 risk mitigation issues of diversification, “offsetting risk” and reinsurance, in addition to pooling.⁸¹ Additional risk mitigation techniques include the design of contract features and asset management strategies, such as asset / liability management techniques that provide a sharing of risks by customers 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 treat the effect of these various risk mitigation techniques in the measurement of liabilities of insurance contracts and in total financial resources is needed. Sections 7.1 through 7.8 contain such a discussion.

The issues discussed in Section 7 are relevant to all accounting frameworks. The relative importance and relevance of these techniques can differ among jurisdictions, types of insurance contracts, and markets.

⁸¹ Note that pooling, diversification and offsetting all involve the combination of risks. The distinction between them is that diversification involves a combination of dissimilar risks (diversifying risks), pooling involves a combination of similar risks (pooling risks), and offsetting involves risks that are negatively correlated (offsetting risks).

There is a cost associated with the application of any risk mitigation technique. Although under some current accounting frameworks expenses related to risk mitigation are excluded (e.g., it may exclude 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 to the value of the item being valued), the cost of mitigation is integral to the effect of the mitigation and not to the act of mitigation. To the extent that there is uncertainty associated with the cost of mitigation, the price or cost associated with this uncertainty would be reflected in the risk margin.

In addition, it has become apparent that the effect of risk concentration (i.e., the opposite of risk diversification) should be considered at the same time. This is addressed in Section 7.9.

Each issue addressed in Section 7 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 a risk margin, in whole or in part, then the issues would also be addressed from the perspective of the reference entity.

7.2 Pooling

Pooling is a risk mitigation device often used in insurance to reduce volatility, that is, to reduce random fluctuation around the expected (mean) value of a portfolio of similar contracts. Pooling does not, of itself, reduce the uncertainty about what the mean value is⁸², but it does reduce the expected deviation around the mean, expressed as a percentage of that mean. Thus, a small insurer or a business unit within a large insurer can lower its risk from statistical fluctuation of its results on its insurance contract liabilities by writing additional similar contracts. Thus, the effect of the law of large numbers facilitates a greater confidence in the interpretation of the results from the pool, which means that a larger number of similar risks can increase the confidence in the estimate of an expected value based on the pool's experience.

The expected value per contract for a small group of contracts is the same as the expected value per contract for a larger group of contracts. However, the risk distribution for the smaller group is wider (i.e., has a larger coefficient of variation) and possibly more skewness than the risk distribution for the larger group of contracts. Thus, combining or pooling similar risks results in a reduction in the statistical risk per contract (also referred to as process or random deviation risk).

To the extent that pooling refers to the treatment of similar insurance risks in the aggregate 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.

The extent to which an incomplete level of pooling should be reflected and, if it is, how, is a question that has been the subject of considerable discussion at IAIS and IAA committee meetings.

⁸² While a larger pool of similar contracts can reduce the uncertainty of an estimate of the mean, if this estimate is based on data from the pool, this is a different effect from what we are discussing here. The estimate of the mean could, for instance, be based on a much larger population of risks or the true mean could, in cases such as many fair gambling games, be known exactly.

The objective expressed in IAIS (2007), “similar obligations with similar risk profiles should result in similar liabilities”, has been interpreted to mean that a portfolio of contracts in a relatively small pool of similar contracts in one insurer should have the same liability value as that portfolio would have in a larger pool of similar contracts in another insurer. In this case, guidance or developed practice may be needed about the size of the reference pool to be used to reflect the effect of pooling in measuring liabilities⁸³. If this interpretation is applied, the effect of a smaller actual pool size should be considered in total regulatory assets required (risk-based capital). Conversely, if the actual portfolio size exceeds the reference size, the insurer would reduce its capital requirements rather than reducing its liabilities or increasing its assets.

The IASB has indicated that if a price for a risk is observable, it should be reflected in the value of liabilities. Therefore, to the extent that the relevant market includes an additional price for a smaller portfolio, it is appropriate to reflect this price in the risk margin. If a truly efficient market exists for any size portfolio, either mark-to-market or mark-to-model measurement of a transfer price of a pool of contracts would not include a process risk. In practice, however, as real markets are rarely fully efficient, there will likely be a residual process risk. While this residual process risk may not be significant for some lines of insurance, the potential impact of certain catastrophe risks⁸⁴ may be.

Note that where either a sufficiently large reference entity is used or an efficient market is assumed, the differential effect of pooling would usually be reflected in the risk margin, as it would normally be expected that a small portfolio of insurance risks would be traded on a market at a similar price per contract to a larger portfolio, with the price based on the pooling possible in a large portfolio. Conversely, if the price in a market is higher for a small portfolio or if the reference entity is assumed to be of the same size as the actual portfolio being measured, process risk would be included on that basis. Further research and discussion may be warranted in this area.

7.3 Risk diversification

A risk or portfolio of risks is diversifiable if a large enough number of dissimilar risks is available to spread the fluctuations caused by the risk so that the variability of the total portfolio is less than the combination of the variability of each component considered in isolation. The distinction between diversification and pooling is based on the degree of similarity or dissimilarity of the risks involved. This similarity can be assessed on one or more of a variety of different characteristics of the risk, for example, class of business, location of risk, marketing channel, and type of insured.

The IAIS has referred to the consideration of volatility in its *Common Structure Paper* (2007), 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

⁸³ For instance, the reference pool could be assumed to be sufficiently large to experience minimal process risk. But note that such an assumption is clearly unrealistic in relation to many types of insurance risks.

⁸⁴ An asteroid strike, California or Japanese earthquake, Yellowstone volcano, Atlantic tsunami and Atlantic coastal windstorm, are a few examples.

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 that a market participant can diversify the risk. The rules of the financial reporting system will affect both the boundary between pooling and diversification and the extent to which diversification is considered in the measurement of contracts.

An entity that writes only one line of insurance is called a mono-line entity. Advantages of this type of entity might include being perceived as a specialist in the market or in having the expertise to reduce costs from losses or to achieve lower operating costs. Note that in some jurisdictions, regulators have restricted the writing of specific type of insurance contract, such as mortgage guarantee insurance, to a mono-line entity. Conversely, a mono-line entity does not have the advantage of being able to spread risk among 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, thereby lowering its risk margin. If a law or regulation does not permit the consideration of such diversification in measurement, a benefit from diversification for reporting cannot be achieved in practice, although such treatment is inconsistent with the underlying economics involved.

When combining different lines of business (e.g., automobile and property risks), the remaining risk after consideration of pooling within each line could be diversified to some extent by combining portfolios. The risk distribution for the contracts combined would have a lower skewness and coefficient of variation than the average values for each line considered independently. 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 inter-portfolio diversification effects are permitted to be considered.

When considering off-setting risks (discussed in Section 7.4), to the extent that uncertainty and risk are demonstrably reduced, the treatment of offsetting-risks or diversification 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 have the ability to diversify and seek diversification, observable prices will likely reflect such an effect.

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 by necessity involve diversification by including a mix of insureds, occupations or regions. As a result, a more appropriate way of thinking about this decision is the extent that diversification will be recognized and not whether it should be recognized.

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

7.4 Offsetting risks

Offsetting risks is a risk mitigation technique that takes advantage of the negative correlation of the uncertainty associated with a second set of obligations or rights to reduce the risk for the first set of obligations or rights. This can be distinguished from pooling and diversification by a focus on negative correlation. Weak negative correlations are not normally recognized as offsetting.

A special case of offsetting risks is matching or, as subsequently referred to, hedging (note that hedging in an IFRS context is a defined term that is more narrowly applied, referring only to matching by use of a derivative). Hedging achieves its risk mitigating effect by the use of strongly negatively-correlated risks (risks with a correlation of minus one or close to minus one) that are otherwise independent from the offset item. Although derivatives are often designed to completely offset a certain risk, they 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. Consequently, the offset might not be effective in all circumstances.

Other examples of offsetting can be designed to match the risk by referring contractually to the risk born by the entity, that is, it transfers the specific risk of the entity directly to the counterparty. It can take the form of reinsurance (discussed in Section 7.5) or risk-retransfer to policyholders (e.g., through participation features as discussed in Sections 7.7 and 7.8). Such techniques are usually directly linked to the effect of the risk offset, thus effectively reducing or eliminating a part of the risk otherwise born by the reporting entity, except for any default risk associated with the counterparty. However, offsetting of risk as discussed in this section refers to a situation where there is no direct linkage, that is, the risks do not necessarily directly or explicitly offset each other.

A well-known example of offsetting is where whole life insurance contracts and whole life payout annuity contracts are written by the same entity. The level of mortality for life insurance is different from the level of mortality for life annuities, reflecting both selection and anti-selection. However, more importantly, the trends in mortality for insured lives and annuitants are highly correlated. Thus, a trend in mortality usually affects both portfolios, but its effects are in the opposite direction. This effect is strongest when the two sets are similar, for example, they have similar age profiles. 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, there are two alternatives regarding the effect of risk mitigation on liability values. The first is to ignore the risk mitigation effects in the measurement of the respective liabilities. The second is to reflect the effect of a reduction of volatility in each set of risk margin calculations for the two offsetting portfolios.

The IASB's current *Framework* seems to imply that the effect of offsetting at a level higher in an entity than the portfolio of similar risks that are similarly managed should not be reflected in the measurement of a liability. The basis for this position is an assertion that the effect of offsetting risks would not normally be reflected in a transaction price for a contract or a portfolio of contracts by market participants. If treated in this manner, the offsetting effect would be reflected only as a reduction in capital requirements of an entity.

An opposing view is that market transaction prices that reflect the potential for offsetting should be reflected in the risk margin, even for entities that do not actually have offsetting risks. The view taken is often related to corresponding views about the unit of account and whether inter-portfolio diversification should be considered.

If it were determined that this offsetting of risks would be expected to be reflected in market transactions, it would then be appropriate to reflect offsetting in the application of the cost of capital method in determining risk margins. If there is an effective hedge available in an active market for the risks inherent in a tranche of insurance contracts, then the lowest bidder for the liabilities would be expected to be an entity that could make use of them as a hedge, in which case it would be appropriate to reflect the cost or benefit of the hedge, regardless of whether the risk is actually hedged. The market price for the hedge, if available, would be the best evidence for the market price of the corresponding risk.

7.5 Reinsurance

Reinsurance can be distinguished from hedging with derivatives since it is itself an insurance contract and the contract refers explicitly to the risk born by the entity and not to an external index. It is effectively a transfer of a risk born by the entity to another entity⁸⁵, that is, a cession through a reinsurance treaty.

IFRS 4 indicates that the appropriate accounting treatment for reinsurance is 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. Nevertheless, it is always necessary to consider counter-party risk in the measurement of the ceded reinsurance asset.

IASB (2007) paragraph 219 indicated:

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.

⁸⁵ Some view reinsurance as an extension of pooling and diversification beyond the direct insurer. In effect, the reinsurer creates pools of risks drawn from many direct insurers and accesses the benefits of this pooling and of diversification across these pools. In some cases, reinsurance creates explicit diversification benefits for a direct insurer, as where protection is given against all losses from all classes of business affected by a particular event (catastrophe cover) or against the aggregate of all losses suffered by the direct insurer (aggregate excess-of-loss).

- (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.

For proportional reinsurance this issue can be illustrated by considering the simple case, illustrated above, of an insurer writing life insurance contracts for amounts up to \$5,000,000, but retaining only the first \$50,000 on each contract. The block of such insurance contracts with reinsurance will have a rather more “well behaved” probability distribution than that of the block including the reinsured amount. The amount of losses of the entire directly written block of business will have a longer-tailed probability distribution than those of the retained block of business.

The question is whether separately calculating the risk-adjusted ceded reinsurance asset and the risk-adjusted direct liability will produce a preferable balance sheet presentation.

It is theoretically possible to determine the risk margins for the risks underlying the direct insurance liabilities and corresponding reinsurance assets independently. However, this would ignore the risk mitigation effect the ceded reinsurance has. It would be desirable for 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 corresponding 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 9, *Accounting for Reinsurance Contracts* (2007).

Non-proportional reinsurance can be more complex. An insurer might have a portfolio of property insurance contracts with sums insured up to \$100 million, protected by risk excess-of-loss reinsurance where the insurer pays up to \$250,000 on each claim and the reinsurer pays the excess over \$250,000. In addition, because it has many insured properties in some areas, it also has event excess-of-loss (catastrophe) reinsurance, which covers the excess over \$1,000,000 for any one event. The insurer’s net (retained) result under such an arrangement can be significantly more well-behaved (i.e., have less uncertainty) than the ceded business.

The effect of non-proportional reinsurance on expected cost is proportionately less, often much less, than its effect on the coefficient of variation of the risks. The impact on skewness and higher moments is greater still. Although the general principle that, before allowance for reinsurer default, the risk margin for the reinsurance asset should be consistent with the risk

margin for the ceded liability still holds, the effect is not proportional to the risk margin applicable to the retained liability. The ceded portion of the risk is usually far more uncertain than the total risk written. Care is needed to ensure that the net risk margin is appropriate to the retained obligations. This can be achieved by estimating the net risk margin directly on a net of ceded reinsurance basis, so that the ceded risk margin is the difference between the direct and net margins, rather than calculating the net margin as the difference between the risk margins for the direct and ceded portions.

This approach uses the greater stability of the net result to determine a much more reliable estimate than is possible using the more volatile gross and ceded probability distributions. It should be noted, however, that the net expected cost and margin must both include due allowance for the risk of reinsurer default.

While a large life insurer can usually operate with minimal amounts of ceded reinsurance, reinsurance is usually a key risk management technique for specific types of risks for all insurers and for all general insurers, even for the largest insurers or reinsurers. By making greater use of reinsurance to moderate their net risk profile and hence their cost of capital, smaller insurers are able to offer premium rates that are competitive with those of larger insurers, despite the fact that the gross variability of the amount of their claims is proportionally greater. Because this is standard market practice, it follows that, if used for the purposes of setting a risk margin, a reference entity would be assumed to make appropriate use of reinsurance and to set its prices on that basis as well.

7.6 Contractual features related to assets and asset management

Although risk mitigation approaches involving the management of assets are usually not directly related to insurance contracts, some are indirectly related and are briefly described in this section.

Typical investment-linked contracts determine benefits payable to the investment performance of a specified and separated portfolio of assets held by the insurer. This arrangement is not considered to constitute hedging, but rather a cession or re-transfer of those returns to policyholders. Other contracts are designed in a manner that the result is matching as described in Section 7.4, that is, where the obligation refers to the value of specified a set of assets traded in active markets, such as an index, regardless of whether the insurer holds them. Such contracts are referred to as index-linked contracts (if an index or indexed-fund is used). Depending on accounting guidance for hedging and netting, differences in the measurement between these two types could be significant.

In some countries, it is relatively rare for a pure investment-linked contract to consist solely of 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 involving performance guarantees (e.g., involving one or more of a minimum level of: death benefits, investment return, income and withdrawal benefits) related directly or indirectly to the account value.

The account value can be viewed as being a component of the contract that might be separately valued (bifurcated or unbundled), although expected management fees and the guarantees provided are usually based on the account value. By forming this account, all or most of 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, often 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 expected investment return itself in this case, the insurer could have potentially very significant risks through the other contract features.

In some other types of insurance contracts, a designated set of assets can be allocated to a portfolio that may not be directly allocated to individual policyholders in a proportional manner. In some cases, the shareholders' share, if any, of the surplus generated by these contracts is limited, usually to a specified percentage. In exchange for that limitation of profits, shareholders are provided with a cushion against risk, usually in the form of early premiums that are greater than would have been charged without this contract feature. Other contracts have features that limit the insurer's risk through, for example, non-guaranteed elements such as the cost of insurance or expense loading fee. Those contracts, often referred to as participating contracts or contracts with adjustment features, are addressed in Section 7.7.

Other risk mitigation strategies, such as the use of options or futures, are sometimes applied. These are referred to as asset/liability management (ALM) strategies and techniques. The objectives of these strategies are to reduce mismatches between the cash flows associated with an insurer's assets and liabilities and to ensure that they are managed in a consistent manner to reduce reported investment losses, reporting variability and liquidity risks. To the extent that they are managed successfully, insurer losses will be mitigated. Usually the expected results of these strategies and techniques are reflected in capital rather than in the measurement of liabilities if accounting principles do not allow the consideration of the effects of matching or hedging, or the extent of hedging achieved.

A less specific approach is to use a replicating (minimum risk) or matched portfolio as a benchmark against which the actual investment strategy is compared. Under this approach, performance is seen as comprised of two parts: the insurance result, which is measured on the basis of the benchmark investment strategy, and the value added by investment management, based on the difference between the actual and benchmark portfolios. Such a division is consistent with the idea that, unless the liabilities are, in whole or in part, dependent on the assets, the value of the liabilities should be a function of the insurance obligations alone

7.7 Contract adaptability features

Many insurance contracts (in some markets practically all available contracts written by life insurers) include features that either require or permit an insurer to modify the cash flows otherwise due or payable to the insurer in response to the entity's experience or performance subsequent to the outset of the contract. This may apply to cash inflows or outflows. These features include policyholder dividends and bonuses, contract charges, fees, credited interest and adjustments to premiums and contractual benefits.

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 provided on a basis not directly related to current performance of the insurer. In between these two extremes, the value might be determined by reference to, for example, an external

index, the accumulated surplus or deficit arising from a group of contracts, or expectations raised by benefit illustrations.

Considering the wide variety of such features, their particular economic nature and risk mitigating effect would have to be evaluated on an individual basis to determine their proper treatment. For example, such features can provide for the total of all results to be shared and re-transferred to all of the policyholders in the portfolio as in a mutual entity, or they might even constitute additional risks for the insurer, depending upon the guarantees that are included. Further, a discretionary feature might contribute additional complexity, for example, in claims settlement. Discretionary features are addressed in Section 7.8.

The extreme case is insurance at cost, for which investment-linkage as described in Section 7.6 is a special case. In such a case, the insurer might be entitled to receive a fee or a proportional share in generated surplus. Consequently, such features are quite similar to a reinsurance cession or re-transfer, where the result of each contract is ceded to the community of policyholders, since the contracts refer specifically to the surplus of the insurer. These contracts require that the actually realized margins in premiums in the aggregate are ultimately refunded more or less to the applicable policyholders as a group.

Many of these features are referred to as participation features. They are distinguished from investment-linkage or a cession of those investments by the retention by the insurer of a share in their performance, a set of minimum guaranteed benefits for the policyholders, and some flexibility in providing the generated surplus to the policyholders. Further, policyholders share in any surplus generated from the contracts, not only their investment performance. The cession is usually incomplete, as in some cases they are combined with index-linked features and usually include amounts that are to some extent provided at the discretion of the insurer.

In some cases, such as term insurance sold at premium levels far less than the maximum allowed under the contract (a maximum that might have been set to avoid holding additional regulatory liabilities and never contemplated to be charged), it would be highly unlikely that the maximum amount would ever be charged in the future. If it were, not only would significant shock voluntary terminations occur, but the entity's franchise value would suffer as well. Similarly, some contracts are sold on the basis of interest being credited in excess of the minimum guaranteed crediting rates. The difference between the amounts expected to be paid under each of a range of scenarios is discretionary. Further discussion of these features is given in Section 7.8.

If circumstance forces the entity to forward parts of the surplus generated to policyholders, but grants the insurer the option to charge greatly increased premiums or even to retroactively adjust premiums or benefits, the effect of this option would be considered in the measurement of the contract's liability.

In general insurance, group insurance and reinsurance there are several additional mechanisms used to transfer variability back to the insured, including:

- Policy excesses and limits, strictly speaking, do not fall into this category, since they are limits on the risks transferred to the insurer, but need to be allowed for in assessing both expected costs and variability.

- Experience rating, where the premiums for subsequent periods vary depending on past experience, does re-transfer variability, but not in a way that relates to liabilities, unless those future premiums are recognized as part of the same contract.
- Profit sharing typically returns part of any positive difference between a designated benchmark and actual experience to the insured. Indirectly, the aim is to reduce both liability and variability by encouraging better risk management on the part of the insured. The direct effect is to create a profit sharing liability and reduce overall variability.
- Less commonly, except in the context of reinsurance or cooperative insurance where post-assessments can be made, additional premiums may be payable, usually subject to a cap. Again, overall variability is directly reduced by the creation of an offsetting asset.

The approach to measurement of those features that directly link to the performance of the insurer requires measurement consistent with the linked performance to avoid double counting of risk margins and an accounting mismatch. For example, for benefits directly determined by the value of investments held by the insurer, the linked obligations would be measured at the reported amount of those investments. The obligation in that case would be created by the emergence of a sufficient amount of surplus and would therefore be recognized on that basis.

However, in some jurisdictions benefits can be provided that are not directly linked to performance, but rather determined on the basis of other conditions, for example, the competitive or economic situation. In these cases, benefits triggered by events prior to the reporting date are reflected on a probability-weighted basis.

In some jurisdictions, insurers can retain the amount of realized surplus for some time for the future benefit of policyholders. The extent of the amount of such retention is not always realized in advance, becoming apparent only when tested in litigation. Current IASB recognition guidance (IFRS 4) indicates that such amounts can either be reflected in liabilities or in capital. In some cases, flexibility exists regarding payment of less than the current rate of payment (e.g., percent of surplus, excess interest over the minimum guarantee or expense charges less than maximum allowable). To the extent that the resulting risk to the insurer is reduced, the risk margin for these insurance contracts would also be reduced; this flexibility would also affect the credit characteristics of the insurance contracts (see Section 8.3).

7.8 Discretionary benefits

To this point in this section, the risk mitigation techniques described involve insurer actions taken either outside the contract (through pooling, diversification, offsetting, reinsurance and asset management) or through product design (through product adaptability or risk re-transfer to the policyholders). In addition, many insurance contracts provide benefits that are not specified (either as to amount or the method to be used to determine the amount) in the contract. These non-guaranteed features can take the form of (1) a share of the surplus generated by a pool of contracts in excess of the amount determined contractually or through law or regulation or (2) in benefits that either exceed the amounts guaranteed or in charges that are less than those guaranteed. They can be provided as a result of competitive forces (at the time of sale or to maintain the contract in force or in a premium-paying status) or determined on the basis of an equitable allocation of generated funds.

Since these latter amounts are not guaranteed, they can be viewed as being of a discretionary nature and at the same time provide the insurer risk mitigation opportunities. In contrast with amounts directly determined from the rights and obligations under insurance contracts, these benefits may be treated differently, depending on their characteristics. In a current estimate, the expected cash flows of these non-guaranteed benefits would be included in a manner consistent with the derivation of the guaranteed benefits. Nevertheless, to the extent that the applicable accounting regime does not recognize such benefits in the measurement of a liability, all or part of them would instead be recognized as part of capital.

In some cases, contractual options are available to the insurer, for example, to accept requests of policyholders regarding modifications of contracts or, much more relevantly, within the limits of contract adaptability features. In other cases, insurers may, but need not, make use of contract adaptability features, for example, premium adjustment clauses. Further, non-guaranteed features provide an insurer the opportunity to reduce the interest credited in certain contracts (subject to a minimum guarantee) and to increase expense or insurance loads (subject to a maximum guarantee). And participation features in some cases may grant insurers an option to influence the amount or timing of a certain share of policyholder bonuses/dividends in a manner different that provided in a formula.

Although insurers usually have the ability to pay more than actually required by the contract, they typically make use of that ability through participation features, paying more bonuses than actually required under that feature for marketing reasons, or through other non-guaranteed elements, such as in claims settlement or by paying benefits in excess of that contractually required, for example, to reward persisting policyholders or provide insurance on an at or better than a market clearing price.

Although those benefits are discretionary, if the insurer has a sufficient track record of paying these additional benefits or the industry has historically paid similar benefits on a regular basis in expected circumstances, policyholders might consider their expectations regarding these benefits in their decision to purchase the insurance contract. Their discretionary character may allow the insurer to reduce those payments if the performance of the contract is otherwise not sufficient, the insurer is in a financial emergency situation, or if the expected conditions affecting the entire industry result in similar decisions by others in the market. Nevertheless, if the insurer does take such action in a manner inconsistent with its competitors, then it may experience anti-selection and contract terminations in excess of the level priced for. In any case, insurers would prefer to have such risk mitigation opportunities available, to the extent acceptable by policyholders.

In some jurisdictions, “reasonable policyholder expectations”⁸⁶ can limit the application of discretion. The resolution of the potential tension between the principle that only present obligations result in a liability and the principle that a realistic and consistent view of the future should be taken depends on the applicable standard, the existence of an economic trigger (e.g., the competitive situation) and the facts and circumstances involved. Ignoring discretionary but expected benefits in the measurement of the liability may result in the premature reporting of profits, particularly if a transferee would be expected to provide similar discretionary benefits.

⁸⁶ In at least one case, benefits that the insurer believed to be discretionary have turned out to be legally enforceable on the basis of reasonable policyholder expectations.

In some cases, a single feature can incorporate both discretionary and non-discretionary elements. The extent of discretion available can be limited as a result of initial or subsequent contract sales illustrations, policyholder dividend/bonus resolutions by the entity's board of directors, required regulatory approval or competitive pressures.

IASB (2007) indicates 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 that are subject solely to the discretion of the insurer would not be reflected in the measurement of a liability for general purpose financial reports. In a strict sense, this would exclude even that discretion which is constrained by "economic compulsion", that is, where the insurer is for marketing reasons, to uphold new business or persistency, is forced to provide such benefits. Nevertheless, in some jurisdictions and for some contracts, such payments are payable under circumstances that are equivalent or quite close to being a constructive obligation, for example, where regulators require insurers to pay bonuses/dividends on the basis of initially determined asset shares or asset shares consistent with actual future conditions. Another example might be when the amounts are included in at-issue sales illustration provided to an applicant for a contract and the insurer's Board of Directors passes a resolution to pay amounts consistent with the current sales illustrations, as long as experience is consistent with current expectations.

In contrast, the IAIS does not favour the application of such a strict recognition principle and considers that a current estimate would recognize all the amounts expected to be paid. Such expectations should be consistent with the expected future experience and economic scenarios for which the remainder of the liability is based upon.

The treatment of the insurer's discretion can be clarified by contract, law or consistent industry practice. However, judgment may be needed to determine whether the amounts not guaranteed by contract, law or constructive obligation should be categorized as a component of the current obligation.

The discretionary element can help mitigate the effect of adverse conditions and enhance the manner by which an insurer can manage its contractual risks. In some cases, all or part of the original risk transferred to the insurer is re-transferred to a pool of policyholders.

Risk margins reflect the risks to the insurer under a contract or portfolio of contracts, after consideration of the expected utilization of those features. Reductions to the risk margins would reflect the expected effectiveness of these risk mitigation tools compared with the risk margin for similar contracts that do not include such a possible adjustment.

Limitations on the freedom of an insurer to exercise these features can reduce the extent of discretion available. These might result from such sources as contract terms, applicable law, regulatory action, and fiduciary position. For instance, a regulator might require the use of asset share results to determine provisions for bonuses/dividends. In contrast, in other circumstances, the distinction between an obligation and discretion can be blurred. Some insurers use discretion as if they are required to provide such benefits, without testing the extent to which an obligation actually exists, legally or otherwise.

Depending on the jurisdiction, industry practice or experience, non-guaranteed benefits or charges that are not directly related to generated surplus or experience and are subject to insurer's discretion might be assumed not to be paid in extremely adverse conditions. In such cases, it may not be appropriate to reflect such expected benefits as a liability, even though they

would be expected to be paid in the normal course of business. Another approach might be to reflect a corresponding smaller amount to be paid in the applicable possibility adverse scenarios on a probability-weighted basis.

7.9 Risk concentration

Risk concentration, that is, a large percentage of a portfolio's risks in a certain category of risk, whether the category is determined by residence in a single geographic location or subject to the same risk, can be an important risk consideration for insurance entities. Examples include situations where there is potential for earthquakes, tsunamis or weather-related losses such as hurricanes, or for large losses resulting from terrorism or from changes in a judicial ruling that impacts a single geographical area.

By writing contracts over larger geographic areas, the risk of a single loss event affecting a large portion of a portfolio would be smaller. The result would be that the current estimate of losses will be more certain and the entity's risk margin as a proportion of current estimates would be lower. Risk concentration is not restricted to location, as it can relate a relatively large exposure to any characteristic of insureds, for example as those subject to a particular hazard, such as directors' and officers' liability in a volatile industry in a litigious jurisdiction. Another example is where a large portion of invested assets is of a particular type.

There remain measurement challenges in the estimation of the expected effect on liabilities and provision for potential large losses. The IAA *Blue Book* indicates that capital and surplus would be used to absorb the effect of "catastrophes" with low probability, high severity, and a large degree of uncertainty. Nevertheless, the question of how to determine the degree of concentration or tail risk that would be significant enough to qualify as a catastrophe remains an issue for continuing study.

IFRS 4 does not allow what in some countries are referred to as "catastrophe liabilities" or "equalization liabilities" to be recognized as liabilities, that is, amounts aggregated in years without catastrophes to cover losses from future catastrophes. Such amounts do not reflect a current obligation, as such a provision would represent an accumulation of past premiums less claims, which does not bear any particular relation to the future expectation of these risks. When permitted or required, this amount typically was available to smooth earnings, recognizing a portion of a past premium as contributing to a future "smoothing" liability that could be used to offset the effect in income 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, that is, be based on current expectations, its expected value for the unexpired term of the contract would be reflected in the measurement of its liability.

Risk diversification and risk concentration should be treated consistently with each other in the measurement of insurance contract liabilities.

8. Other Issues

8.1 Service margins

All insurance contracts provide for multiple types of service, ranging from asset management, claims settlement, to premium billing. IASB (2007) indicates that the liability for insurance contracts measured on an exit value basis (i.e., on a market-consistent basis) should not only reflect the expected cost of providing for these services, but the entire price that would be charged by a market participant for providing such services. This includes both the current estimate of the cost of providing such service and a margin for the service. For a market-consistent estimate, such a margin represents the estimated compensation required by a third party or a market participant to provide (or arrange to provide) relevant services.

Although some insurance contracts contain an explicit fee for such services, most provide for them implicitly without specification in premiums. Given the bundled nature of insurance contracts, the corresponding revenues for these costs are usually considered together with other cash flows associated with the contracts, and do not necessarily match either the timing or the actual cost for those services. Contracts cannot be sold without such fees and services.

Most services are provided internally. However, there are many exceptions to this. For example, commissions are paid to agents/brokers to acquire and to preserve insurance contracts in force, investment management firms are often used to manage parts or all of an insurer's investment portfolio, and janitorial services are often outsourced. Nevertheless, a large share of such expenses is provided internally.

The stated objective of a service margin is to avoid the front-ending of expected profits associated with such services. The price paid by market participants for the entire insurance contract would then be considered to include the service margin, along with the current estimate and risk margin.

The elements of such a service-related 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 likely would reflect entity-specific assumptions based on entity strategies and efficiency.
2. Servicing risk. This risk would be provided for in the risk margin. This includes the risk of contract persistency, timing risk of the expected expense, and measurement uncertainty (associated with estimating the expected value of future expenses for the contract until the completion of the insurer's obligation). This element is no different in concept from the corresponding risk associated with other cash flows associated with the insurance contract. This risk is particularly important in an insurance contract in which the contract or claim period is lengthy.

3. Service profit. This represents the portion of the price for which a third party purchaser or provider of the service would charge in excess of (1) and (2). This would be provided for in the margin for services.

A belief that the size of element 3 might be relatively large is the reason the IASB Board included an explicit margin for services in its proposed method of measuring liabilities in IASB (2007). Another motivation was an attempt to treat the service component of an insurance contract in a manner similar to the treatment of the insurance component and consistent with the current approach used for stand-alone service contracts in IAS 18, *Revenue*.

A problem with the application of such an approach is that in most cases the amount of a service profit (element 3) in a bundled insurance contract is usually indistinguishable from that of a charge for the servicing risk (element 2) and from the insurance risk element incorporated in the risk margin.

It may not be practical to separately determine or model the equivalent of this charge in a non-arbitrary manner. However, it may be possible to reflect this charge for expected profit, either thought of in terms of a market-consistent view of service provided from a party external to the entity or as an internal transfer charge in part, to the extent that a risk margin can be determined to provide for it.

However, there is a difference in opinion as to whether internal expenses should be grossed-up to reflect element 3 above. In part this difference arises because of the lack of availability of reliable and relevant price data on services associated with an insurance contract. In most cases, insurers have determined that they will provide the services internally. Because of its fiduciary responsibilities, in most cases in which services are provided externally the insurer still has to provide oversight functions related to these services. The only reason for using an external service is if the expected external costs and associated risks, together with internal oversight costs, are less than internal costs associated with the services. Thus, one measurement approach would be to reflect the entity's expected internal expense, or a market-consistent price for the services plus a loading for oversight.

Alternatively, the profit margin associated the service elements might be reflected as part of capital or, if a "no profit at issue" rule is applied (see Section 8.2), it would be included in the total margin as a non-observable part of the margin. The IASB staff have indicated that a separate calculation of the service margin will not be required in phase 2 of its Insurance Contracts project, but expects that its effect may be combined with the risk margin.

Nevertheless, 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). According to IASB (2007), if a contract explicitly or implicitly provides for charging of a fee for services that market participants require, the insurer would recognize an asset at initial recognition, measured on the basis of the cost needed to originate the contract. If market participants require an explicit or implicit service fee greater than the cost, the initial asset would be less than the origination cost that market participants would typically incur (in extreme cases this could be negative, in which case it would be a liability).

It should be noted that if the price for outsourcing such a service is not available, then the distinction between the three elements of a service component may be difficult to determine.

Note that the treatment of the cost of providing service for general purpose financial reporting is still not decided at the time this paper was written, but paragraph 62 of the IASB (2007) indicates: “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 a margin in the context of an accounting system's measurement objective for liabilities that does not permit an initial profit to be recognized. Although the IASB and the IAIS may require insurance contracts to be based upon exit or settlement values that permit a “profit on issue”, profit at issue may be prohibited altogether or allowed only if the associated uncertainties are sufficiently small. If profits at issue are not allowed to be recognized, a “total margin” approach, rather than a risk (and service) margin approach, might be used, in part due to the difficulty in distinguishing risk and profit. Note that even 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 rule is to “gross up” the risk (and service) margin measured by one of the approaches described in Section 6 by an amount to produce a zero profit at issue. Although this method might be extended to disallow a loss at issue as well (i.e., a negative risk margin), such an extension is usually thought to be inappropriate. Alternatively, a risk margin could be determined in a manner consistent with Section 6 and a residual (possibly reflecting the residual expected profit after reflection of the present value of expected cash flows and margins associated with the contract) determined separately. In either approach, the effect of the trued-up parameter(s) or residual factor would be released over subsequent periods of the contract.

The following are possible approaches that could be applied after the contract is issued:

- Use one of the risk margin approaches described in Section 6 for the life of the contract (and any consequential claims). This would result in the amount withheld as profit at issue flowing immediately back into profits, which would defeat the objective of the constraint, since the gain would be recognized in the period of issue. The result would be no different from only using the risk margin.
- 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 confirms 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 will require further investigation.
- Calibrate the total initial margin to an equivalent quantile or confidence level or cost of capital, depending on the risk margin approach used, with subsequent adjustments made only when the price of risk demonstrably changes, consistent with

a current entry approach, the price at which the current parties to the contract would agree to enter into the remainder of the contract.

- Calibrate the total initial margin, to be runoff 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 one or more of the major profit drivers of the contract, as is currently done in Australia for life insurance in a Margin on Services approach.

Alternatively, the initial total margin could be separated into one or more of its components and released on separate bases, although this would be more complex. In addition, there is no principled basis on which to run off the residual margin.

If the risk exposure changes substantially, for example, from a stand-ready obligation to an incurred claims obligation, a methodology is needed to determine how the change should be handled. This methodology would need to cope with IBNR claims, as well as reported claims. Alternatively, the treatment in the two periods might be independent. In any case, the three components to the total margin could be treated separately:

- The risk margin would be released as the risk obligations is settled or expected to be settled, on a basis appropriate to the remaining risk. It may increase as claims are reported
- The service margin would continue until the service obligations are settled, on a basis appropriate to the remaining service obligations.
- There is no principled basis over which to run off the residual. Possible carriers could include premium payment and the risk and service margins.

If the risk margin is determined separately, as an explicit part of the total margin, it may be appropriate to disclose both margins. In any case, it would be appropriate to explicitly determine the margin used. As can be seen, some of these methods would not necessarily be consistent with a current value approach.

8.3 Credit characteristics of the liability

The purpose of this section is not to discuss whether to directly reflect the credit characteristics of a liability under an insurance contract issued by an insurer (sometimes referred to as “non-performance risk” or “own credit standing”), as that has proven to be quite controversial, but rather to discuss possible approaches that might be used to measure this risk if it is required. IASB (2007) indicated that the credit characteristics of the liability should be reflected in the measurement of liabilities for insurance contracts for general purpose financial reports, although it indicated that it was not expected to be significant in most instances. In contrast, the IAIS has strongly opposed such an adjustment for financial reports used for regulatory purposes, expressing its view in its Second Liabilities Paper with respect to general purpose reporting.

If credit characteristics of a financial instrument are applied, it is logical to apply these characteristics through the discount rate, the primary income driver of such instruments and the primary metric through which they are priced. If significant insurance elements are included, a

more relevant approach may be to reflect these characteristics as a function of the expected cash flows to which a credit event might better relate.

Broadly, credit risks associated with the liability for insurance contracts can arise from the effect of a bankruptcy or serious financial difficulty of the insurer (possibly limited by guarantees from the State or a guarantee fund) whether caused by fraud, underpricing of the insurance contracts, poor performing assets, or significant adverse past or expected experience. The extent or source of credit problems is a function of the balance between assets and liabilities of the entity that is responsible for the payment of the cash flows of the contract, and not the contract itself. It should be noted that the level of costs of an insurance contract is not necessarily related to whether the cash flows of that contract will be paid.

Because the lack of payment is not necessarily related to the interest component of the insurance contract, discount rates may not be the most appropriate base to which it should be applied for insurance contracts. If applied to the cash flows, then it may be more appropriate to reflect the uncertainty associated with these characteristics as part of the risk margin.

Reflecting the credit characteristic of the contract is equivalent to considering that the liability cash flows to be valued are not certain to be paid, that is, there is a risk of non-performance or non-fulfillment of the obligations of the contract. In practice the shareholders of an insurance entity do not have unlimited liability. They typically 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 a reduction in the amount of policyholder net cash outflows. 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 (e.g., through a state-sponsored guarantee fund or even a “too large to fail” condition) 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 desired 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 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.

Although the preceding paragraphs refer to the credit standing of the entity, it is not the intention of the IASB to reflect its credit standing per se. Rather, it is the credit characteristics of the contract, as is clear from the following extract 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*.

Nevertheless, the credit standing of the entity does affect the credit characteristics of the contract for the period of the contract. 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. Debt related to insurance liabilities is categorized as the most senior debt of an insurer.

Also, the protection against significant financial distress can include actions taken by a state-sponsored guarantee fund or a regulator-arranged business combination, particularly if the financial difficulty was due to systemic risks such as a pandemic of bird flu, a crash in the financial markets, or if an insurer is too important a financial institution to let fail. A sudden decline in solvency can also lead to a situation where capital markets are no longer willing to supply further capital to the entity in support of its contracts. As a result, the extent of the credit-related risk may differ by jurisdiction and by type of contract (e.g., a regulator may have death benefits payable in full, while allowing a haircut on surrender benefits). Nevertheless, in some extreme cases, the impact of credit may be material.

Rating agencies provide claims paying ability (CPA) ratings specifically aimed at reflecting the expected chance of non-performance of the obligations provided for in an insurer's contracts, evaluating this risk in their normal ratings process. 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 can be problematic for several reasons, including the following. Although most relate to the entity, these may also be used to apply to the contract.

- The methodology used by the ratings agencies to derive claims paying ability ratings, usually applied to the entity, is thus not perfectly applicable to an individual contract, and may not be 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 or claims paying ability, it may make 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 also 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 an unduly favourable estimate of the effect of own credit standing on an insurance obligation, as it only applies to losses after 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 a credit spread for the liabilities of insurers of different ratings to be observed. However, although this implies that there may not be an observable

metric to which ratings can be calibrated, qualitatively it may not be that much different from deriving estimates of credit risk on a modeled basis.

- 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.
- Regular assessment of the insurer's credit rating, as it would be expected to affect the contract, is needed. The results of this assessment would vary with market risk preference and thus 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. Separating the effect of a change in credit characteristics and market risk preference may be problematic.
- In a market-consistent valuation, the entity to which the credit characteristics of the liability apply has to be determined. It could be the entity that is the current bearer of the net obligations, the likely market purchaser(s), or a reference entity, based on expected credit conditions. This may be determined by the applicable accounting standard under which the liability is being measured.

The risk of non-performance of a contract 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 may be difficult.

To the extent that the credit characteristics of an insurance contract are applied to its liability on a gross of ceded reinsurance basis, an inconsistency may exist between this liability and the corresponding ceded reinsurance asset. This might arise if the value of the contract's ceded reinsurance asset reflects the credit characteristics of the applicable reinsurance treaty, involving a particular reinsurer and the credit characteristics of the underlying insurance contracts.

In summary, the default option does exist. Although entities are not generally managed with a view to exercising 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, recognition of these credit characteristics in a market-consistent valuation may be justifiable. If a non-market-consistent valuation methodology is applicable, an adjustment may not be appropriate. In most cases however, the level of allowance is likely to be very small given that the likelihood of the default option being exercised is remote and protection against non-performance may be provided by a state-sponsored guarantee provision. Also, objectively assessing an appropriate allowance may prove difficult, although banks who are complying with U.S. GAAP SFAS 157 have shown that it can be done. Nevertheless, certain users are proving 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 its insurance contracts. However, for general purpose financial reporting, the IASB considers operational risks to be directly related to the performance of the contracts and thus includable in the liability for insurance contracts.

During its deliberations, the view of the RMWG has been that certain aspects of operational risk might be reflected in the liabilities of insurance contracts, but has not determined what an appropriate split might be. For example, although operational risk might be only directly reflected in capital requirements, the cost of holding that capital could be included in the cost of capital in the determination of a risk margin.

The purpose of mentioning operational risk in this paper is to note that a decision is needed on where (and the basis on which) operational risk is to be reflected 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. The risk margin includes risks inherent in the operational processes considered in the current estimate.

8.5 Governance

A thorough discussion of relevant governance issues surrounding the measurement of liabilities for insurance contracts is outside the scope of this paper. Nevertheless, governance issues are important, in part because they encompass insurance entity controls, surrounding every element of the process used to develop relevant measurements, including the use of data and use of internal models (see the IAA papers on Internal Models and Enterprise Risk Management). Internal 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 ultimately responsible for measurement decisions, actuaries are the experts who are usually involved in providing the technical support that enables this responsibility to be carried out in an appropriate and objective manner. As such, actuarial practice should ensure transparency in documentation and their presentation of measurement estimates is important. Effective communication of the methods and assumptions for all significant elements used in the measurement of liabilities for insurance contracts, to the appropriate preparer's decision maker, as well as to the users of financial information through effective disclosure, is important.

Appendix A – 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 followed to develop this paper.

A1 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 and the IAIS accepted the IASC's invitation to participate in the IASC Insurance Steering Committee and at the same time the IAA formed its Insurance Accounting Committee to liaise with the IASC.

In addition, the IAIS launched its own project to establish Core Principles of insurance regulation and related regulatory guidance and standards through its Insurance Contracts and Solvency Subcommittees. The IAA Insurance Regulation Committee was formed to in turn liaise with various IAIS subcommittees.

In 2002, the IAA's Insurance Accounting Committee began developing International Actuarial Standards of Practice (IASPs) for use in conjunction with what was to become IFRS 4, the result of the first phase of the IASB's insurance contracts project that was adopted in March 2003

In 2004 the IAA's 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 form the conceptual foundation underlying future IAIS solvency developments.

In 2005, the IAIS Insurance Contracts Subcommittee undertook to develop the IAIS's *First Liabilities Paper* (2005) 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. In 2006 the IAIS followed with its second set of observations in the paper known as its *Second Liabilities* paper, adopted in June 2006. Representatives of the IAA were active participants in the development of both of these IAIS papers. .

In developing these papers and its solvency regime, it quickly became apparent that to achieve a common IASB / IAIS liabilities measurement template for insurance contracts, the key issue was what risk margins above current estimates would be used.

This led the IAIS's Solvency Subcommittee to draft 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 June 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 follows.

A2 Terms of Reference

The formal title of the IAIS request is "Approaches to the Determination of Liability Values and Quantitative Benchmarks for Technical Provisions" that is included in its *Roadmap Paper* (2006). To carry out this request, the following Terms of Reference were adopted by the IAA's RMWG.

A2.1 Scope and objectives

"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."

"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."

"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 behaviour exists, it can be arrested before insurers become vulnerable to failure."

A2.2 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.”

“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.”

A3 Process followed

The RMWG held several face-to-face meetings, beginning in 2005, as well as frequent exchanges of e-mails and conference calls between meetings.

Several IAA representatives attended the meetings of the IAIS Insurance Contracts and Solvency Subcommittees and the IASB Insurance Working Group. Similarly, IAIS representatives and IASB staff attended RMWG meetings, as well as IAA’s Insurance Accounting Committee, Insurance Regulation Committee and Solvency Subcommittee meetings during this period.

In addition, the IAA representatives to the IAIS Insurance Contracts and Solvency Subcommittees were able to provide input to those subcommittees as they developed the IAIS’s *Second Liabilities Paper* (2006), the IAIS’s *Roadmap Paper* (2006) and the IAIS’s *Common Structure for the Assessment of Insurer Solvency Paper* (2007) that reflected the developing RMWG research.

In the course of the development of this paper, the RMWG distributed two exposure drafts, in February 2007 and March 2008. Twenty six and seventeen written comments were received in response to its first and second exposure drafts, respectively, all of which are posted on the IAA website.

Over time, the paper's scope has become somewhat generalized and has provided a more rigorous context, in parts by addressing both regulatory and general purpose financial reporting issues and examples and by expanding somewhat into a few areas, such as discount rates, as well as more focused in other areas, not addressing data and other detailed requirements needed to enable the determination of reliable and robust values for supervision purposes.

The original co-chairs of the RMWG were Paul McCrossan and Henk van Broekhoven. 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. The contributors to the final paper, including several IAA member associations and interested parties who provided comments on the exposure drafts, are too numerous to mention here, but their assistance was quite valuable. Special note is given to Ralph Blanchard, Bob Buchanan and Stefan Engländer.

A4 Note regarding terminology

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” as used in this paper. Subsequently, in IAIS *Second Liabilities Paper* (2006), the IAIS adopted the terminology “current estimate” to refer to the unbiased estimate of 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”. “Current estimate” in some jurisdictions has been referred to as “central estimate” or “best estimate”.

Appendix B – Current Estimate Assumptions

This appendix contains a discussion of selected specific assumptions (measurement inputs) used in 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, that may involve the derivation of a range of probable values.

B1 Mortality rates

In this appendix, 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) the *level* that describes expected mortality during the last observation period and (2) the *trend* that describes the expected changes in mortality over the period of coverage, beginning with the period from which mortality was last observed. Most of this discussion also applies to survival rates.

B1.1 The level

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 for reasons that include the effect of underwriting (selection) at issue.

The effect on mortality from selection decreases as the period since underwriting increases. The mortality rates during the time these differences exist are called *select mortality*. The period of select mortality depends on the extent of underwriting, age at time of underwriting and other risk characteristics of the insureds. Experience has shown that the effects of selection can last from 5 to 25 years, with a shorter period where voluntary termination rates are high. Select mortality can be validated using relevant experience data of the particular insurance portfolio or a similar insurance portfolio subject to comparable underwriting standards. This validation process is referred to as a mortality study.

There has been a trend in certain countries to group insureds in smaller categories, including those considered preferred risks, whose risk characteristics such as smoking and blood pressure status are expected to experience in lower than average mortality rates. Because of the lack of experience for these groupings over time, it is currently uncertain how fast and how long the preferred risk mortality differential will wear off.

Mortality after a select period is referred to as *ultimate mortality*. If a portfolio of contracts experiences considerable voluntary terminations, for instance at or near a particular time (e.g., after a significant premium increase), or if the contract is issued with limited or no underwriting, the effect of anti-selection (e.g., because unhealthy lives are less likely to terminate, giving rise to mortality higher than the ultimate level) may be experienced over time. Even if only limited

voluntary terminations occur or if contracts are underwritten, mortality may differ depending on the insurer's target market.

The mortality rates for most payout annuities will be lower than population mortality because individuals who choose to purchase payout annuities are usually healthier than the general population.

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 often been expressed as an adjustment to age (e.g., insured mortality age x = population mortality for age $(x-5)$) 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 as the contract ages. These adjustments may also vary by gender or other risk classification factor.

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 following considerations:

- 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; and
- anti-selection effects caused by available termination options.

If premiums do not differ by values of a risk characteristic, the resulting observed experience according to the risk characteristic may not be the same as when premiums do differentiate for the risk characteristic. This may be due to a factor such as adverse selection by the insureds.

A special case is where an insurer cannot legally differentiate premiums, for example by gender. It may be reasonable not to use gender-specific mortality tables for financial reporting purposes, for example for portfolios with a stable gender mix and adequate experience from the portfolio. Alternatively, experience by gender may be available from the portfolio or other portfolios with no pricing differential by gender in the same type of market. The experience by gender from these portfolios might be used if it reflects the experience of the actual mix of insureds in the portfolio.

The experience of the current portfolio or of similar portfolios of insureds is often the most relevant experience available. This will seldom be available in sufficient size to provide a fully credible measurement base. In cases where this experience is fully credible (i.e., of a sufficient size and homogeneity to stand on its own), it would be used. More often, it would be used in conjunction with other evidence, such as suitably adjusted industry or population mortality experience, giving weight to the portfolio experience according to its credibility.

In countries with insufficient information about the effect of a risk characteristic on outcomes, care is needed to use information from another country. This is due in part to possible differences in susceptibility to certain medical conditions among different populations. For example, the effect of smoking and obesity on mortality is not the same in all countries or regions.

In certain cases, statistical relationships between the experience of different insured groups cannot be precisely measured or can only be approximated. If that is the case, the use of appropriately adjusted experience from a less refined grouping of insureds may be reasonable in the circumstances. If possible, the reasonableness of such groupings or the adjustments made would be validated in some manner, possibly through credibility techniques based on numbers of expected claims or volumes of business. Important factors that are often 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.

If an estimation of mortality rates using age-dependent factors cannot be determined because the amount of relevant experience is too small (e.g., for a niche market), an alternative approach that might be applied is to use age-independent factors or theoretical mortality models (e.g., Gompertz or Makeham).

In the case of observed groups that are too small, products are sometimes 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 cases where no observations are available, (margin free) tables derived from industry experience are sometimes used, with a constant percentage adjustment applied to all the mortality rates (e.g., +/- 20%, depending on an assessment of the relative effectiveness of the underwriting screening performed and the market penetrated). Such an adjustment may be constant for several years, and some adjustment may be appropriate even over a long period. As a percentage, the adjustment would normally decline as the portfolio ages. The less accurate the data, the higher the uncertainty, which results in a higher risk margin assumption.

B1.2 The trend

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 and current century, mortality rates have decreased (life expectancies have increased). For most insured populations, mortality rates are expected to continue to decrease in the future. An important measurement issue is how fast the mortality rates will decrease and for how long.

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 –)
- Behavioural effects (+ or –)
- New diseases (–)
- For insured populations, changes in underwriting methodologies (+ or –).

The effect of these trends can differ by population category. For example, the net effect by age or gender may differ due to the relative effect of these factors, for example, a new disease may significantly affect the very young but not affect those in their middle ages, and changes in smoking habits can affect a cohort of insureds (those born in a particular period) over a long period of time. Because a predominant cause of death for young adult males in developed economies is motor accidents, road safety initiatives can have a significant effect on mortality for this group.

Mortality rates for insured lives may be affected by improvement in underwriting methodologies (e.g., blood testing) or deterioration as a result of reduced underwriting screens, perhaps necessitated because of the cost of the screens compared with their expected value.

The rate of change in mortality rates has not been and is not expected to be constant. Several changes in trends have occurred, for instance, in periods of increasing mortality rates in certain population segments, 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.

The effect of these three drivers of change in the U.S. and some Western European countries has been offset since the mid-1970s by medical developments and behavioural 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). 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.

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 that attempt 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 method⁸⁷), sometimes supplemented by expert medical opinions.

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 three or four age segments, such as:
 - child mortality (decreasing by age);
 - large middle age segment with relatively constant accident causes (except for certain age groups such as young males); and
 - large middle age segment with mainly sickness causes (gradually increasing by age); and
 - aged portion (exponentially 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 are often 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 at the same conclusions about 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.

Just as is the case with other assumptions, the validation of their reasonableness is important. Do the future levels and relationships among the mortality rates 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.

The expected level and changes in policyholder behaviour, particularly policyholder persistency, can affect the mortality of a portfolio. This behaviour can vary by such factors as premium or bonus/dividend patterns by duration or age, factors that may not be the same for current product designs available in the market, or changes in health of the individual insured.

⁸⁷ Lee and Carter (1992)

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 type of trend analysis. In addition, if changes in significant underwriting procedures or criteria have been applied over time, trends in general population mortality data 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 in the use of general trends, without adjustment. It may be appropriate for the experience of both types of population to be considered. As with the level of mortality, evidence regarding trends from portfolio experience would be given weight on the basis of its credibility.

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 (e.g., van Broekhoven (2002)).

Depending on the volume of the experience base, it is often necessary 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.

The time period over which a trend factor is to be applied needs to be determined. Differences of opinion exist regarding the application of a trend factor over different periods, especially 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. In contrast, there is the possibility of a fundamental medical breakthrough that will result in the extrapolation making inadequate provision for future improvement for payout annuities, or a significant adverse change in human behaviour that will lead to the opposite result.

Although most actuaries are used to estimating and applying some type of trend in mortality improvement in the case of annuities, whether to be realistic or in part to be conservative, some feel uncomfortable with applying such trends to life insurance contracts in which improvements in mortality represent less conservative results. Although this may affect the risk margin applied, there are few conceptual reasons (e.g., anti-selection) why, for a given age range, the expected trend factors would be different for these two types of coverage. If there is such a difference, it might be a sign of the use of such trends for prudence purposes, which may not be appropriate in certain financial reporting systems.

In some jurisdictions, there is an implicit assumption that premium rates for some products 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 on inforce business from time to time, to reflect improving mortality. The alternative would be to incorporate an offset to improving mortality to allow for deterioration of mortality as a result of selective lapses triggered by premium rates that are not reduced.

Mortality trend models are based on various factors, such as attained age and year of birth (cohort). Historical trends are not always evident in various cohorts, although age effects have been. In addition, sufficient observations for recent birth-years are not commonly available from which to produce projections. As a result, the future effect on such cohorts can be difficult to estimate. Mortality projection models that project historical experience and are currently in common use include:

- Lee-Carter, used in several countries, is based on an ARIMA model. A problem with this method is 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.
- P-Spline⁸⁸. This method has been used in the U.K.
- Extrapolation of 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.
- The first of these three methods can be combined by using a “goal table”. This means that the mortality in the far future (e.g., in 2050) is based on ideas in the medical and demographic world. It can incorporate an additional increase of the life expectancy because of important medical developments. The starting trend is still based on one of the three methods mentioned before. How this can be applied can be found in van Broekhoven (2002), which is briefly discussed in Appendix B1.3.

B1.3 An example of determination of the current estimate for mortality incorporating historical information about level and trend

The chairperson of the RMWG, Henk van Broekhoven, published a paper (van Broekhoven (2002)) concerning the use of 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 van Broekhoven (2002) used 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

⁸⁸ CMI (2007)

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 that measures 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.

B2 Property and casualty (general) insurance claim development

In this appendix section, the estimation of future cash flows relating to property and casualty (general) insurance claims (and related expenses) for claims that have already been incurred is discussed. This liability includes estimates for claims that are reported and unreported at the measurement date. In general, these are assessed here in the context of a gross of ceded reinsurance basis of measurement, that is, it does not reflect the effect of the specific measurement of, or credit risk associated with, ceded reinsurance assets. This appendix 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.

It is common to use multiple methodologies in the process of developing estimates for these cash flows, sometime with the final estimate resulting from a blend of the estimates from the differing methodologies, sometimes relying on judgment.

Appendix B3 discusses estimates for unexpired risk liabilities for a stand-ready obligation, that is, claims that have not occurred on contracts written and the estimation of potential reinsurance recoveries. Except for cases in which there is evidence to the contrary, estimates of the stand-ready obligation use the early experience (i.e., relatively soon after claims are incurred) underlying the estimation of claim development.

Although the following primarily relates to the liability for property and casualty insurance claims, much of it also relates to claim liabilities for other insurance coverages, particularly for many forms of health insurance.

B2.1 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 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 factors are assigned on an average basis depending

on the type of claim involved, although this is usually done when claims are expected to be small or before sufficient information about the claims is obtained to allow assessment 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 liability refers to the sum of (1) the pure IBNR, and (2) a liability for incurred but not enough reported (IBNER), which is 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 case estimated claim liabilities.

Alternatively, claim liabilities can be estimated in total, without a split between case estimate and IBNR liabilities. Such estimates are usually based on loss payment data but also may use of claim count and case estimate data, to the extent that these aid an understanding of the payment data. 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 expected claim frequency and size, depending on the coverage and data available (these methods are more fully discussed in Appendix B2.5).

Because the claim characteristics and behaviour of a portfolio are intimately related to and dependent on the marketing, underwriting and management of the portfolio, it is difficult to form a reliable view of how market-based assumptions would differ from those derived on a portfolio basis. As a practical matter, if a market-based approach is required, it is typically assumed that, for a particular portfolio of insurance risks, the market would manage the portfolio in the same way.

B2.2 Loss adjustment expense (LAE)

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.

Differences in the definition of LAE categories can be important in any comparison and analysis of trends in these expenses is needed, 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 overheads.

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 settlement, payment and closing.

The level of LAE may also depend on the relative efficiency of the entity's claim management process. Assuming that LAE is an assumption based on non-market sources, 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 is used, then some indication of what the market would charge for this function may be more relevant.

Although in some areas, third party LAE fees charged might be observable (e.g., from third party administrators or outsourcers), recent historical portfolio-specific LAE 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 costs often vary widely by the specific claim portfolio's characteristics and volume of expected claims involved.

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.

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.

B2.3 Exposure to risk, frequency and severity

Where available, analysis of experience is based on exposure to risk, often measured by the premium charged or per contract, with the unit used varying by coverage.

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 as a proxy for exposure to risk). There are several possible measures of number of claims that differ by coverage, for example, the number of occurrences, the number of claimants, and the number of claims. This analysis is not performed as often 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.

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.

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 cannot be easily combined into a single meaningful frequency and severity measure for total commercial automobile liability. Again, premium is often used as a proxy for exposure in such lines of business. However, if premium is used, an adjustment for variation in the general level of premiums over the insurance cycle is usually applied.

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. For long-tail coverages, this can be more difficult, particularly for claims involving possible mass torts or new or slowly emerging types of claims, for example, claims due to asbestos or lead paint liability.

B2.4 Pertinent experience data

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 they are based on the risk characteristics, coverage mix, and types and location of customers covered, as well as other characteristics such as claims handling.

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 less restricted coverages. In contrast, liability measurement will often be based on a wider grouping of coverage, customers, markets and jurisdictions. As another example, where liability is limited to a maximum amount per claim or per year, many entities price using “basic limits”, while relying on industry advisory factors where available to assess the additional cost of higher limits, or utilize models to estimate the additional cost.

Nevertheless, there are many situations in which portfolio-specific experience data do 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 are 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 are generally only available at a highly aggregated 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.

B2.5 Methodologies

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.

For many products, estimated claim liabilities can be based on such methods⁸⁹ as paid and incurred chain ladder (also referred to as link ratio, triangulation, or development) methods, payments per incurred or closed claim, frequency-severity, Bornhuetter-Ferguson⁹⁰ (where a prior expected claim levels based on a relevant exposure base is used for early periods of the claim cohort), Cape Cod⁹¹, Mack's method⁹², 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.

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 forms the basis of the estimate, sometimes differing by claim cohort, often separately by accident, report or underwriting year.

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 assess 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 blind adherence to the

⁸⁹ Hart (2007), CAS (1996)

⁹⁰ Bornhuetter and Ferguson (1972)

⁹¹ Stanard (1980)

⁹² Mack (1993)

same approach(es) from period-to-period, although it is useful to document the reasons for any changes made.

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.

Often a single “current estimate” scenario is developed, for example, 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, for example, 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.

Insurance risks are often subject to skewed claim probability distributions, either the result of the incidence of claims or, more commonly the severity of losses, or both. This often results in estimates resulting from a single “most likely” scenario 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, then 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.

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 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.

B3 Stand ready obligation for property and casualty and other short-period contract periods

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, or offset by, 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, for example, crop insurance, accident coverage of students while in

school, automobile accidents during vacations/holidays or periods of high incidences of ice and snow, 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 present value of expected 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.

In other cases, the stand-ready (unexpired risk) obligation is determined as the current estimate of the present value of the risk-weighted cash flows for claims arising in the future 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. As for a longer-term insurance contract, it is based on an expected value of the cash flows associated with the unexpired term of the contract, 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 not expected to be collected, although no renewal premium might 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.

Many of the same factors discussed in Section 4 of this paper apply to the determination of the expected values used as a basis of this liability. Some differences might include:

- The expected cost of catastrophes for the unexpired risk period would be reflected for the remainder of the current contract period.
- A liability adequacy test (LAT) would not be needed, as the calculations involved already inherently incorporate these expected values. It should be noted that a LAT may be required if current assumptions are not used.

B4 Expenses (other than loss adjustment expenses)

Expense assumptions reflected in the expected value of future cash flows reflect future expenses associated with obligations arising from commitments the entity has entered into through the valuation date. These might, depending on the financial reporting standards and guidance, include some or of the entity's allocated overhead expenses.

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 IASB (2007), 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) could be used, for example, as in U.S. GAAP SFAS 60.

Paragraph 62 of IASB (2007) indicates that in practice, although a market clearing expense level might be a more theoretically sound assumption, "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". 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.

Some applications, including IASB (2007), might also consider the expected profit margin inherent in market prices charged by a third party provider (an outsourcer), reflecting the profit margin for providing a service related to the expected cash flows considered. The use of 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, for example, as in many current reporting standards, all relevant overhead expenses would be allocated and included in current estimates.

Since significant differences can exist in the development of expense assumptions in different accounting standards, it is important to understand the accounting basis under which those expense assumptions will be applied. For example, Phase 2 of the IASB's Insurance Contracts project has not determined at the time this paper was written whether portfolio-specific, entity-specific or market-based measurement of expected expenses is a more appropriate base. Even though portfolio-specific measures are apparently preferable, that is, expense assumptions reflecting the servicing needs of the portfolio measured rather than the service capacity of the entity, most insurance professionals favour entity-specific expense measures, as they are available, and are 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.

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).

An important element in the analysis of entity-specific or portfolio-specific expense experience data is their allocation. Important allocations include those by coverage or line of business, and between first year (acquisition) and renewal (or inforce) expenses. The latter categorization is more important for longer duration contracts.

The level of service and approach to servicing policyholders usually affects both expense levels and voluntary contract termination and renewal rates. It can also have a significant effect on the reported claim experience, both as a result of marketing and underwriting practices and the potential customers attracted by a particular approach to service and the resulting exposures.

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 are usually available for expense assumptions to be determined on a portfolio-specific basis, while for new entities or new products even in established entities judgment is often required.

If practical, when developing a non-portfolio specific assumption, the entity's business strategy to achieve the desired level of service to policyholders, as well as its approach to claim management that can also affect the amount of losses) can be taken into account. Its operational and service-level strategies indicate whether an entity may be more or less efficient than other market participants, while the expense assumption used in pricing an entity's products normally reflects the general level of efficiency in the market.

The use of a portfolio- or an entity-specific approach to developing an expected value 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 the expected improved ultimate level of expenses. It is usually difficult to verify in advance that a cost reduction or control project will achieve an improvement in expenses that exceed its cost, considering the large number of such projects that ultimately do not result in improved expense efficiency.

All relevant administrative cost and applicable commissions would be estimated, although depending on the applicable financial reporting standard, only contractually- or claims-linked expenses may be recognized in the measurement of the liabilities⁹³. Depending on the entity's accounting policy, if the unit of account is the portfolio or the entity, variable expenses and possibly allocated 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 other investment related expenses could be taken into consideration in the determination of the discount rates.

In developing assumptions regarding future cash flows, one-off expenses during the experience period are usually eliminated. However, such expenses would be reviewed carefully, since many entities can incur one-off expenses every year that are similar in size but are of a different nature. In any event, small one-off expenses would not be adjusted for, as these types of expenses usually will recur, even though due to different circumstances.

Another example of the care needed in a study of expenses is that it would not be appropriate both to deduct the current investment in a new administrative system and at the same time reflect the cost savings expected from the system's implementation. Adjustments from recent historical expense levels can go both ways, for example, if a producer convention is not held every year, such expenses should be spread over the reward cycle and an appropriate allowance included in the experience period.

⁹³ Gutterman (2007)

Subject to specific market conditions, expense assumptions for portfolios of contracts of long duration usually assume that the entity will maintain a reasonable level of new business. 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.

Even when the entity's accounting policy indicates that entity-specific expense assumptions is 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 be 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, for example, industry studies, if any, reinsurer advice (particularly for start-ups), third-party administrators specializing in runoff books of business in the case of a wind-up operation, or the entity's pricing assumptions.

Future inflation-sensitive expense cash flows are commonly assumed to vary with the assumed rates of general expense inflation in a reasonable manner. The starting point can be the current level of inflation, with subsequent inflation assumed to reflect the expected relationship between inflation and future interest rates. A factor would then be added to reflect the issuer's level of unit expense trend relative to the market level of price inflation, when justified by the 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, where 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 different 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.

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 and replacement by new servicing arrangements.

Relevant expenses of the entity's holding (parent) entity or a related entity providing inter-group service would also be reflected. In the case of consolidated group financial statements, such inter-group charges will not have an effect on overall expenses, and the liability measurement has sometimes been based on the total actual expenses of the group, not necessarily what is charged. 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, if any, of the amounts charged by an independent third-party or transfer costs used for tax purposes (transfer price) might be appropriate.

The expenses charged to the entity by a guarantee fund (whose purpose is to provide benefits to policyholders of entities that for financial reasons cannot pay them) are a necessary cost to insurers in many jurisdictions. This is usually based on an allocation of these costs charged to the entity, often a function of recent 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 would be based on expected recent changes in the size of the entity, the cost

of recent bankruptcies of other insurers, and expectations regarding future volume of business and insurer bankruptcies would be reflected in the aggregate expense assumption.

B5 Policyholder behaviour

Especially for certain long term contracts, it is important to reflect the effect of the election of policyholder options in the current estimate. If the measurement of the liability is unconstrained by the applicable financial reporting standard (e.g., some accounting systems do not permit certain policyholder behaviour assumptions to be reflected), it would be appropriate to reflect the expected effect of the expected use of these options. See Section 4.7 for further discussion of consistency of assumptions. Special consideration would be given to apparently irrational policyholder behaviour, since fundamental economic theory and models are based on the assumption of rational behaviour.

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, 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, external conditions and insurer behaviour, including sensitivity to interest rate levels and option costs such as surrender charges.

In estimating liabilities, some financial reporting standards require the use of an assumption that policyholders will behave in a rational financial manner. Usually that will result in a disadvantageous effect for the insurer. However, it can be difficult to determine which policyholder behaviour is the worst case.

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). 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 does not seem consistent within their expected economic best interest (e.g., due to convenience, forgetfulness or loyalty to a producer).

Alternatively, what might appear to be irrational behaviour on the basis of what the insurer knows, might be consistent with rational risk preferences in a policyholder's particular situation. For this reason, even if the applicable accounting standard requires an assumption of rational behaviour, its application of that standard on the basis only of what the insurer knows is likely to introduce a bias relative to rational behaviour on the basis of all the facts.

B5.1 Extent of rational behaviour

Based on observation, not all policyholders behave in what appears to be a rational financial manner. Unless constrained, assumptions can fully reflect that the extent of rational behaviour is limited. For instance, even if insurance or investment guarantees are significant, certain policyholders will discontinue their contract in any event for 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 behaviour, particularly on an individual basis, will rarely lead to termination of all of the contracts. This behaviour 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, in many cases, influence policyholder behaviours.

B5.2 Discontinuance rates

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 action such as the payment of surrender or transfer values, exchange for a paid-up policy, or lapsation without value.

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 combination, 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.

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, loss of product specific guarantees by the policyholder, current or anticipated tax and other benefit situation);

- incentives, such as the 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 scenarios and other economic factors (particularly for so-called “interest sensitive” contracts or “options”);
- insurer behaviour and decisions, for example, 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, or exercise of options provided in certain contracts to increase premiums;
- 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 countries (e.g., Japan); and
- expected changes in aggregations as a result of changes in the entity’s portfolio mix.

If not guaranteed, the following will usually be taken into account in the measurement of the surrender value payable on contract discontinuance:

- 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.

For many types of insurance and investment contracts, discontinuance experience normally has a significant effect on overall profitability to the issuer, 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 as the starting point, to be modified appropriately if future conditions are expected to differ significantly from those in the period covered by the experience. 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.

B5.3 Other optionalities

The cash flows of a contract can be affected by the use of policyholder options.

The most commonly offered policyholder option is payment of future premium payments or deposits.

These premiums or deposits may be regularly scheduled or their amount and timing can be flexible, as for many universal life contracts. These contracts 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 use of these policyholder options.

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.

The exercise by policyholders of such options is 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.

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), perhaps with guaranteed minimum terms;
- conversion of a term insurance contract into a permanent life insurance contract,
- allocation of account values among alternative asset funds, and
- exchanges of one life insurance contract for another of a different or similar type, with or without evidence of good health.

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.

Depending on cash flow expectations, the effect of policyholder behaviour 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.

The expected behavioural affect on utilization and cost of any deductibles, coinsurance or experience rating arrangements can have an effect on the claim experience of health insurance and some property & casualty insurance contracts.

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. These options can result in a cost depending on the loan rate provided by the contract and its liquidity risks;
- 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 non-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., in variable annuities or segregated funds);
- choose or change the form of dividend payouts (e.g., cash, paid up additions, term insurance, and accumulations);
- change the Bonus Anticipation Rate;
- choose between a lump sum payment and an annuity at retirement or other annuitization date;
- choose annuity payout forms other than single life (e.g., through systematic withdrawal, joint and survivor, and fixed period) 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.

B6 Other assumptions

B6.1 Insurer behaviour

Insurer behaviour can affect the delivery of certain contractual elements for which discretionary action or method of delivery is allowed or is 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: for example, 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 behaviour estimates under each practical scenario can be quite complex. In addition, insurer behaviour can affect the expenses allocated to provide insurance risk services, such as the method of handling claims.

If this behaviour is restricted, for example by law, regulation, constructive obligations or contract, a single set of behaviour might be assumed to be consistent with the applicable restrictions although alternatively, it might vary (subject to contractual restrictions) by scenario. Alternative behaviour may also be reflected if appropriate (either on a deterministic basis, or if asymmetric risks/costs are involved, using stochastic or representative sets of behaviour consistent with economic and demographic characteristics).

Contractual constraints on insurer behaviour 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 investment earnings credited to date or a committed credited rate;
- annuity benefits, for example, conversion rates, annuitization assumptions (such as the mortality table), and death, withdrawal, living or income benefits;
- guaranteed future insurability benefits, in the form of an option to purchase additional insurance or maintain currently determined benefits; and
- immediate coverage after application signature.

Changes in corporate strategies or risk management techniques, whether in response to changes in conditions or management decisions, would be reflected as they emerge, or in certain cases as they are implemented successfully.

Constraints on the recognition of the effect of this behaviour are common, possibly as a result of contract features, legal requirements, or constructive obligations. Insurer behaviour can also be prescribed based on its board resolutions or entity policy.

Insurer behaviour 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.

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, the financial condition of the insurer, and contracts sold and inforce.

Applicable financial reporting standards may require certain assumptions about expected insurer behaviour. It is more reasonable to assume such rational behaviour based on what the insurer knows, than is the case for policyholder behaviour.

Expected consequential policyholder behaviour would be consistent with assumed insurer behaviour. In addition, assumed insurer behaviour would be consistent with the other assumptions selected.

B6.2 Reinsurance considerations

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 for 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, changes to the current scale of reinsurance premiums or expense allowances that may be dependent on the scenario of cash flows, and recapture options. Action can also be triggered if a reinsurer's rating decreases below a certain level.

Counter-party credit (non-performance) risk would also be taken into account. 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 actual receipt of the expected reinsurance recoveries that affect the measurement of the reinsurance asset or to be recognized as an impairment of the reinsurance recovery asset. The extent that these factors are considered in the insurance liability or reinsurance asset depends upon the accounting standard for reflecting this risk.

All forms of reinsurance, other than quota share, involve option-like properties. These are often most satisfactorily handled by stochastic simulation. As a minimum, they require consideration of individual large claims.

B6.3 Other assumptions

Other assumptions not discussed in this paper include morbidity and recovery rates for contracts involving disability income, health insurance, and most forms of workers compensation, rates and amounts of salvage and subrogation, longevity rates for pure endowments, annuitization, expenses and conversion rates.

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

C1 Coverage and risk distributions

The two principal drivers of risk margins using the methods discussed in Section 6 are:

- the time between the measurement date and the date of settlement of contract/claim obligations; and
- the distributions of possible final settlement amounts (risk distribution).

Table C.1 below shows the percentage of initial discounted current estimate that remains unpaid at the end of each subsequent year for three life insurance products and three for general (property and casualty) insurance products from which we selected values for the examples in Section 6.5.

**Table C.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%			

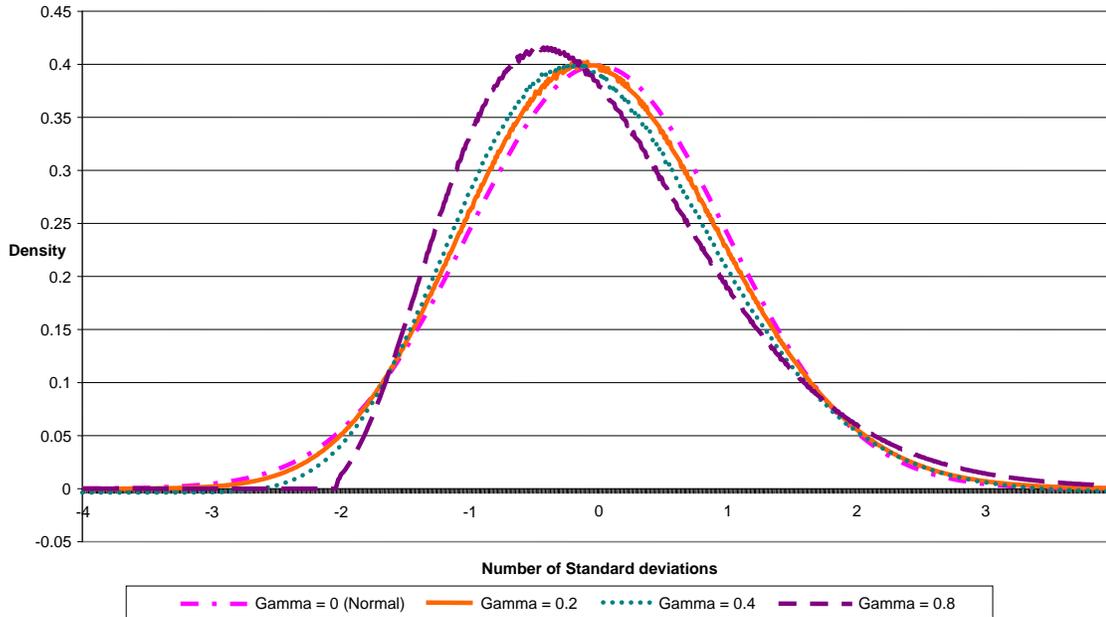
Year	Life insurance			Property & casualty insurance		
	Short	Medium	Long	Short (Property)	Medium (Motor)	Long (Liability)
22			11%			
23			9%			
24			7%			
25			5%			
26			4%			
27			3%			
28			2%			
29			1%			
30			1%			

We selected four risk distributions that are broadly representative of (a) contract 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.

Products A, B and C use compound poisson distribution models represented by the normal power approximation, with selected skewness and coefficient of variation. The normal power approximation is similar to a lognormal distribution with the selected CVs. Appendix C4 compares the normal power approximation to the lognormal distribution. Product D uses a lognormal distribution.

Chart C.2a shows the distributions for the several levels of skewness, assuming that there is no difference in mean or 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. The risk distribution with for Product D, with skewness 8.0, cannot be illustrated with the distribution for Products A-C without losing information, owing to the increase in horizontal scaling. Chart C.3 shows the cumulative distributions for the four products.

Chart C.2a Probability density 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 C.2b shows the equivalent of Chart C.2a with the pairs of standard deviations and skewness levels used for the illustrations in Table 6.1 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 Chart C.2b.

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

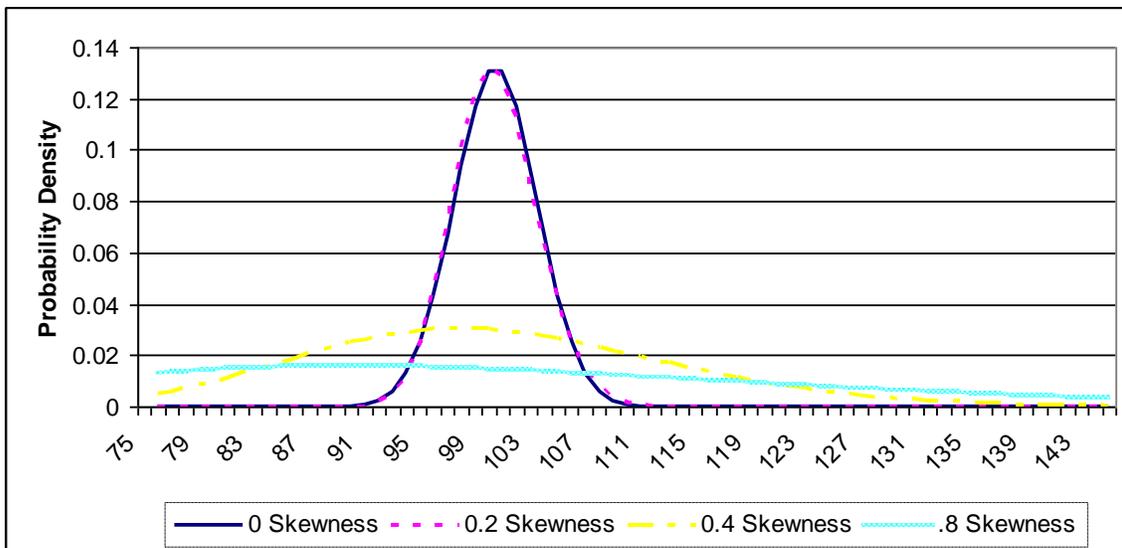
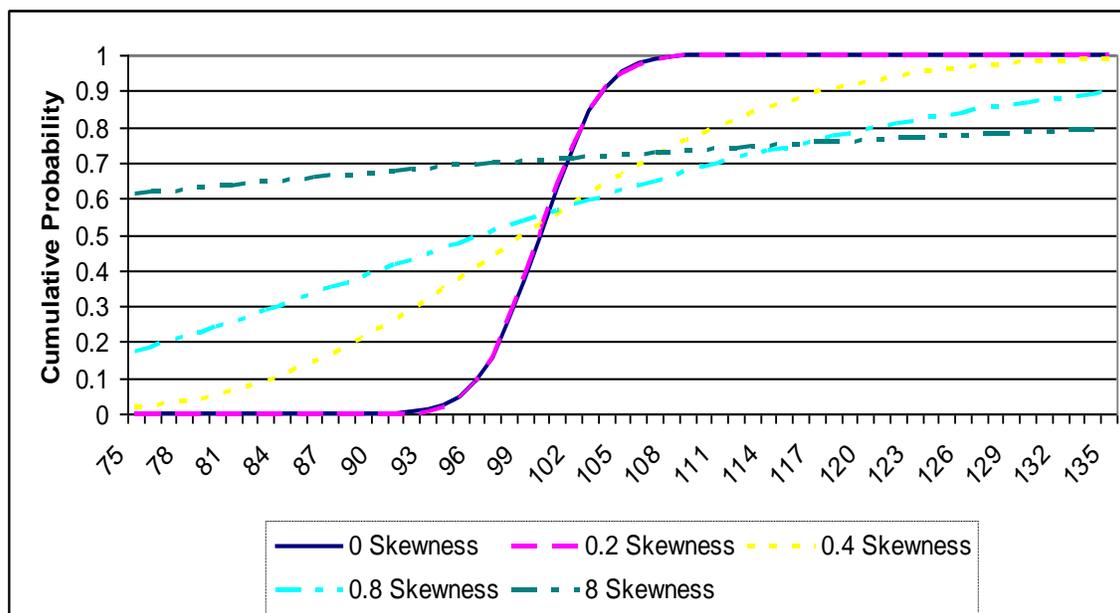


Chart C.3 shows the cumulative probability distributions for the four Products, A-D, corresponding to the distributions in Table C.2a. The chart includes the normal distribution with the same mean and CV as the 0.2 skewness distribution. As in Chart C.2b, the distributions for skewness 0.0 and 0.2 cannot be readily distinguished from each other on this chart.

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



C2 Conditional Tail Expectation

Two of the main risk measures in the quantile family are Value at Risk (VaR, quantile or confidence level) and Conditional Tail Expectation (CTE, also called TVaR and TailVar).

Value at Risk is simply the level sufficient to cover a given percentage of all possible outcomes. Thus, in 80% of cases, the actual outcome will be VaR 80 or less.

A conditional tail expectation is the conditional expected value of that part of a probability distribution that represents losses that exceed a particular quantile.

The mathematical definition is

$$CTE(p) = E(x | x > z_p) = \frac{\int_{z(p)}^{\infty} x f(x) dx}{\int_{z(p)}^{\infty} f(x) dx}$$

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

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

In words, the CTE is the expected value of those outcomes above a given quantile or VaR. For example, CTE 80 is the weighted average, excluding the lowest 80% of possible outcomes. Note that the formulation in its discrete form is outside the scope of this paper.

In many situations, CTE is a better suited risk measure for insurance risks than VaR. One advantage of using CTE as a risk measure is that it provides an indication of the size of catastrophic losses above a certain confidence level when distributions are not normal.

Another is that, unlike VaR, it always gives a positive risk margin. In Section 6.5, for example, we saw that confidence at the 65% level (VaR 65) can give a result that is less than the mean for highly skewed distributions. This makes such methods unsuitable for risk margin purposes in those highly skewed cases.

It is generally anticipated that the 99% CTE level would be similar to a confidence level of 99.5%. In our examples the 60%-90% confidence levels corresponded to CTE levels of 40% to 75%, although that relationship might not hold for risk distributions different from the ones in our examples. The relation between VaR and CTE highly depends on the tail of the distribution. In most cases the higher the skewness, the more difference between VaR and CTE.

C3 Minimum capital requirements and cost of capital formulas

A test for the sufficiency of total financial resources could be formulated in several ways. Two of these are described in this appendix 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 after a year will be 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

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

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:
 1. the discounted mean of the projected cash flows,
 2. risk margin calculated from the Capital Cash Flow (CCF) formula developed below, and
 3. capital equal to the total assets minus ((a)+(b))

The cash flows used to calculate the risk margin 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 current estimate 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 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 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 that Insurer #2 is required to pay and C_1 are uncertain, investors discount the value of the amount returned at the target total return rate of return $r > i$.
- Continuing on to time t , 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:

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

This equation implies:

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

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 current estimates during the course of the runoff period. To remain solvent means that assets exceed liabilities (including risk margins), Test A covers solvency throughout the course of runoff while, under Test B an entity could pass even if it were insolvent during some part of the claim runoff.

Second, in Test A the capital is calculated in such a way that during the runoff the liability estimate might over-state the ultimate payout and the company is considered insolvent even though ultimately it will find there are enough assets to provide for the contract obligations. We call this a “false” failure projection.

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 derived from the risk distribution alone.

As a practical expedient, the above analysis for Test A figures in Table C.4 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 C.4 Risk margins as % of discounted current estimate
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 settlement of claims/contract obligations increases. We can see this effect as shown in Table C.4 because the difference is proportionately larger for products A and C with longer payment periods (by

about 25%) compared to the products B and D which have shorter payment periods (about 10%).

C4 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 C.5 below compares several confidence levels for two distributions similar to the ones used in our illustrations.

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

Probability	CV = 0.133; γ (gamma) = 0.40			CV = 0.261; γ (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, γ (gamma), of the lognormal distribution is

$$\begin{aligned}\gamma &= e^{\sigma^2+2} \sqrt{e^{\sigma^2}-1} \\ &= 3 + CV^2 \sqrt{CV^2} \\ &= 3 + CV^2 CV\end{aligned}$$

where σ is the standard deviation of the normal distribution that has been transformed into the lognormal distribution and CV is the coefficient of variation of the lognormal distribution.

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

$$CV^3 + 3CV - \gamma = 0$$

For $\gamma = 0.20$, $CV = 0.067$

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 is given in <http://www.1728.com/cubic.htm>.

C5 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 appendix section discusses the risk distributions required to achieve that result.

Runoff 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 in Australia, Distribution O would be used, for example, to establish the 75th percentile level, that is, 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 a standard for the amount of capital to be assumed and an assumption about the cost of capital, in each case 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, an additional source of variability needs to be considered. This is discussed in the following paragraphs which also consider the “Change in Capital” or “Transfer Value” Test.

Change in Capital 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, for example, 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 were 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 must be estimated. There are three sources of variation to consider.

1. Changes in the market perception of risk, that is, changes in the compensation required by market participants during that year, for accepting the same risk. This source of variation is like the change in spread between corporate bonds and low-risk government bonds. A difficulty in quantifying this source arises in the case where there is no observable price relevant to the item being measured, or no observable price that is reliable.
2. Changes in 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 present value of the liability at the reporting date (call that E_1 – expected cash flows from time = 1 to ultimate, evaluated with information available at 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 present value based on O_2 at time = 2 we can call E_2 (expected cash flows from time = 2 to ultimate, evaluated with information available at time = 2).

Usually, the ultimate cost implied by E_1 will not equal the ultimate cost implied by E_2 . We define Distribution E (one year time horizon), as the estimate, at the reporting date, of the movement in possible values of actuarial estimates one year hence and the associated probabilities. Equivalently, we can say E is the probability distribution of the values of $(E_2 - E_1)$.

3. Changes in differences between market assessment of possible outcomes and actuarial assessment at the end of the time horizon. There would normally be little difference expected between market and actuarial views of expected values over the long-term, but market views might differ significantly from actuarial views at a point in time if, for example, the recent experience period includes what is considered to be a 1/100 or 1/200 year event. It is often not possible to distinguish movements in risk perception, the first factor, and differences in market and actuarial views of expected values, the third factor.⁹⁴ While we identify this source of difference separately, in practice it might be considered part of the variability in the perception of risk, the first mentioned source of variation.

The change in estimated expected value and change in risk perception would be considered regardless of the risk margin method used. The treatment of movements in estimated expected value is largely the same in all methods. However, changes 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.⁹⁵

Comments

The following three risk distributions have been defined:

1. Distribution O , the distribution most often discussed in actuarial literature and used in practice.

⁹⁴ In normal circumstances we might expect market opinion of expected values to be very similar to actuarial opinion. Also, it can be difficult to distinguish between changes 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 actuarial opinion would indicate. This can be interpreted as risk aversion due to lack of satisfaction with the accuracy of the hurricane damage models used to calibrate those securities and uncertainty regarding whether it was really a 1 in 200 year event.

⁹⁵ However, note that this may not be consistent with the valuation of assets as these generally do not reflect future changes in risk perception

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 contract 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.

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 that imply higher risk margins than Distribution O. For methods based on parameters from a risk distribution, for example, 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.

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

- For contract obligations the relationship between Distribution O and Distribution M is less clear. Adverse developments can include increases in mortality rates (or decreases for annuities), increases in lapse rates and increases in administration expenses. These can be one-year effects (an epidemic, say) or long term effects

(increased longevity, say). They may be mitigated by management actions (e.g., increases in expense charges) 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, for example, 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, as applicable, to ensure consistent practice across companies.

Distributions used in the examples in this paper

As the examples in this paper are presented to illustrate the basic concepts, the examples in this paper did not use Distribution M. The examples in Section 6.5 use Distribution O. The examples in Appendix D use Distribution E. These Appendix D examples assume that Distribution E (one year time horizon) can be reasonably estimated. They also assume that the market value risk distribution over the time horizon is the same as the distribution of actuarial estimates, that is, Distribution M (one year time horizon) = Distribution E (one year time horizon).

Appendix D – Life Insurance and Annuity Risk Margin Examples

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

D1 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).

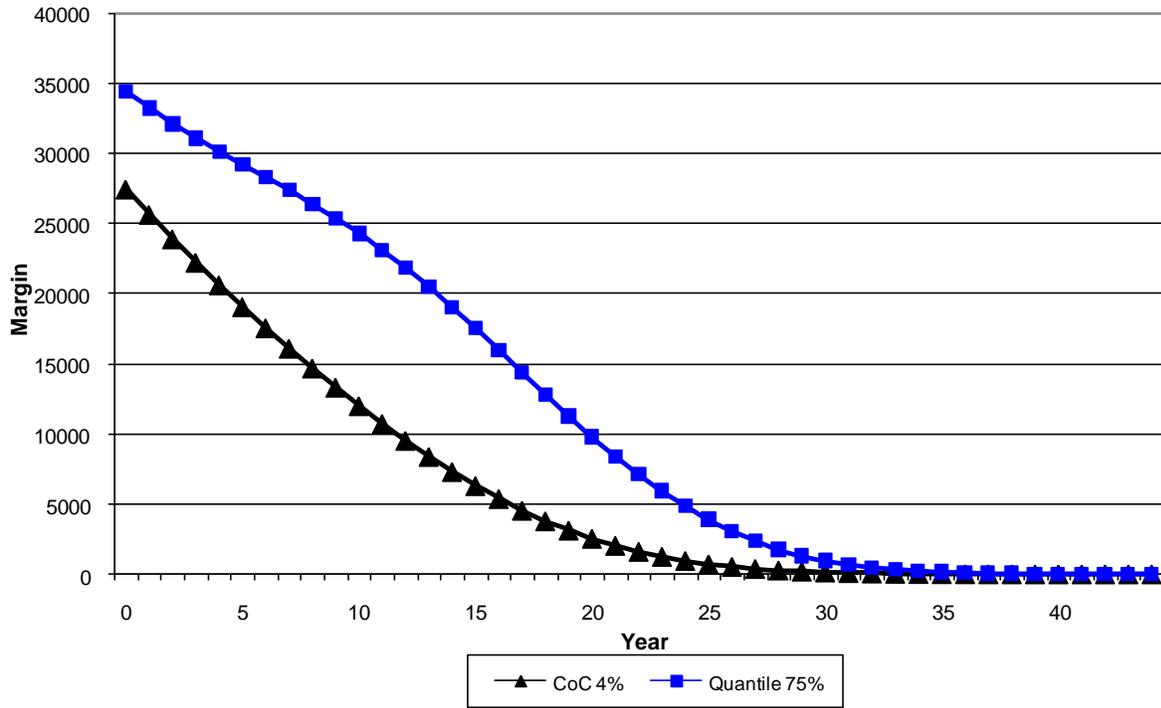
An overview of how the calculations were prepared is given below.

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.

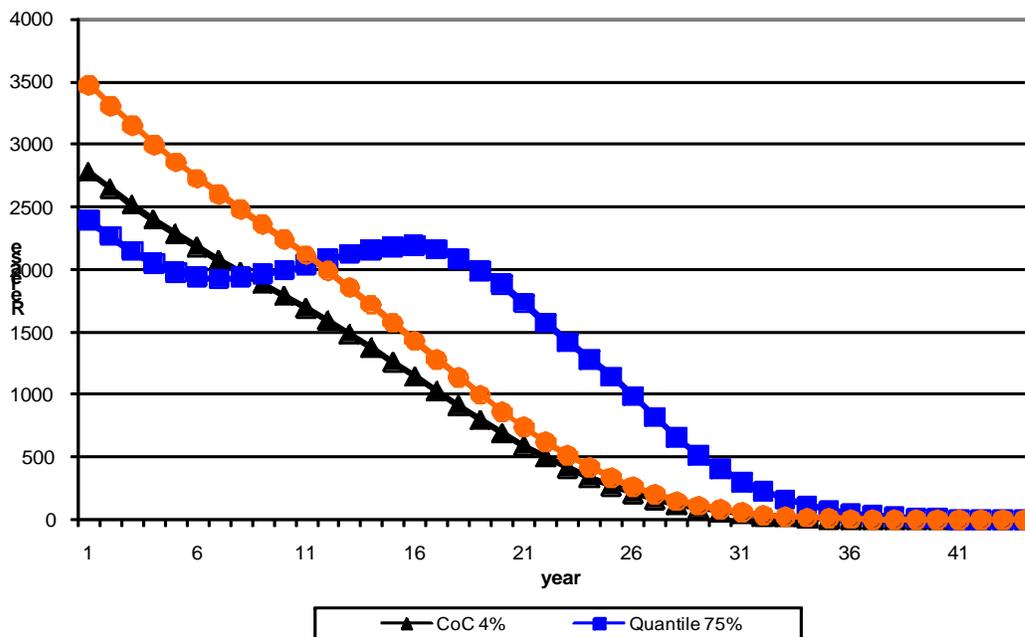
For a AA rated entity, the risk margin for an annuity for 65 year old males is 1.09% of the current estimate for a AA rated entity. The risk margin derived from the 75% quantile method is much higher (1.39%). In comparison, the primary reason for the difference is due to the approach needed to determine 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 D.1.

**Graph D.1 Risk margin comparison
single premium annuity**



In Graph D.2 the release of the risk margin is shown, starting at the same level of risk margin for the two approaches 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 D.2 Release of risk margins over time with consistent initial values 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 as shown in the graph in Table D.1 are presented numerically in Tables D.3 and D.4.

**Table D.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		
Liability	Stand	Stand	Stand	Stand			Cost of	=		
Current	Alone	Alone	Alone	Alone	Operational	Total	Capital	PV(3.5%)	=%	MVL
estimate	Trend	Level	Expense		Diversification	incl.		CoC (8)	(2)	
Year										
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

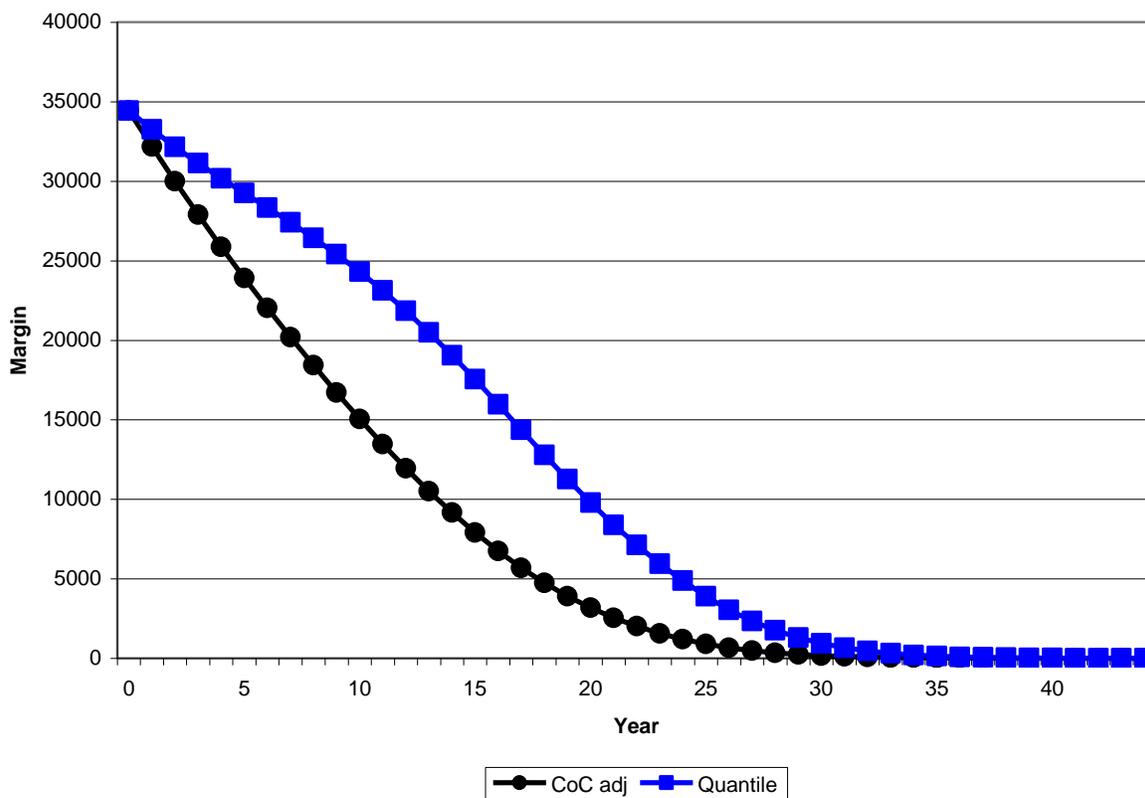
Table D.4 Risk margin based on 75% quantile single premium annuity

(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 cannot 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 margins. Because of a different pattern of release of the capital the margins will differ over time. For ease of comparison, see Graph D.5 for a comparison of the trend in risk margins over time with these equal initial margins.

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



Note that the use of 5.01% to give 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.

D2 Example – Risk margins for a term life insurance contract

The following term life insurance example is based on the same assumptions and models used in the immediate annuity example used in D1. 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 300 years. The impact of this pandemic was age independent and led to annual 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 allowances made for the estimated effects of diversification relating to the components of mortality and mortality related risks are given in Table D.6.

Table D.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 D.7 and D.8.

Table D.7 Cost of capital method based on an 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 D.8 Quantile method based on 75% quantile term life insurance

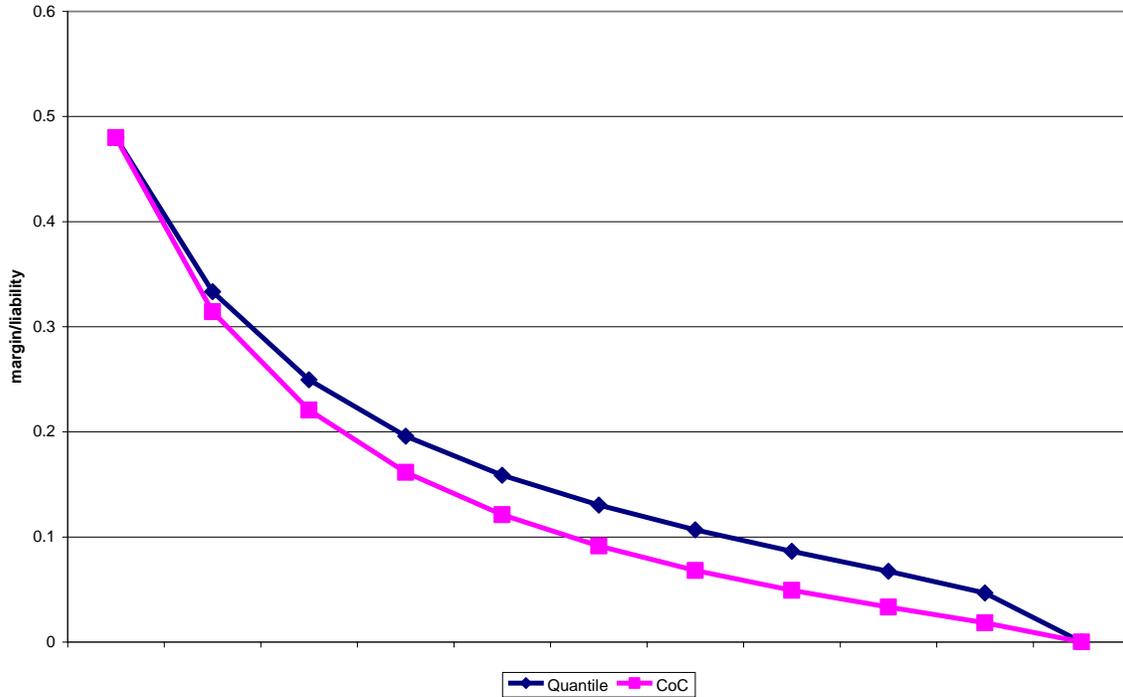
Year	Premium	Liability	Trend	Level	Calamity	Expense	Margin before div.	Div. effect	Margin after div.	Margin % liab	release
0	3634	3,634	1283	1176	75	84	2617	873	1,744	47.99%	-
1	3625	4,727	1103	1119	74	83	2380	805	1,575	33.32%	238
2	3615	5,634	924	1053	74	83	2135	729	1,405	24.95%	233
3	3605	6,312	751	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 shown in Tables D.7 and D.8 above, the quantile and the cost of capital methods give different initial risk margins for the term life insurance contract. To equate the starting level of

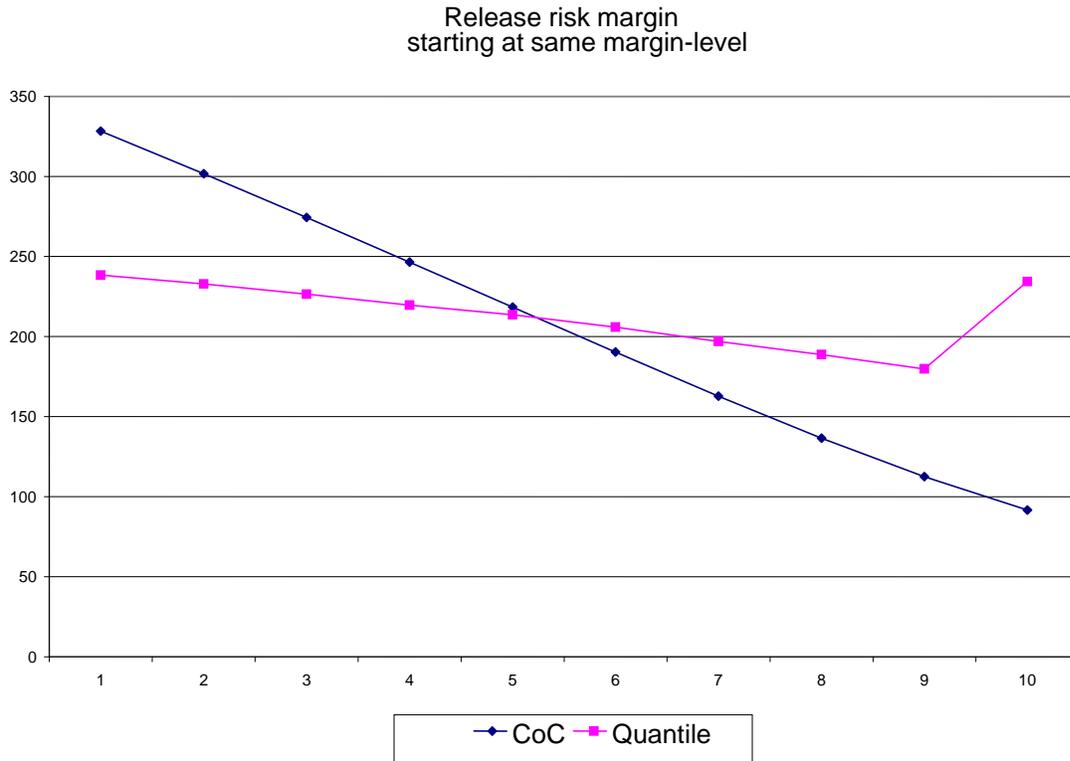
the cost of capital method to that of the 75% quantile, we had to increase the cost of capital from 4% to 8%. Again, this is only the case in this example. Other age/duration combinations would lead to other percentages. In Graphs D.9 and D.10, the development over time of the “adjusted” cost of capital 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 D.9 Risk margin comparison with consistent initial values term life insurance

Comparison CoC and Quantile



**Table D.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 there would not be an equivalent “profit” in the last year.

D3 Models used

D3.1 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 multiplied by q_x .

The average age of the portfolio of contracts is assumed to be 12 years and yearly mortality data from 1950 through 1998 are 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 a significant change in trend was 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 as that 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 ten years.

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

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

The trend uncertainty calculated in this way is a Student's t-Distribution with 8 degrees of freedom (dof). In the Student's 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 D.11 gives the factors necessary to calculate the economic capital with the student distribution.

D3.2 Calculating economic capital using a Student's t Distribution

Factors that can be used to estimate economic capital are shown in Table D.11. They depend on the degrees of freedom, reflecting the number of trends involved.

The factors are then 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 99.5% on an annual basis), and for the quantile method at 90% and 75% confidence intervals.

Table D.11 Number of standard deviations needed in a Student's t 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

D3.3 When insufficient volume of data is available

Sometimes insufficient data will be available to determine certain historical trends for a given population. For example, when new mortality tables are developed only once every 10 years, an insufficient amount of data may be available to determine an adequate historical trend.

In the case where there is a lack of trend experience, a standard set of trend factors may be able to make good this lack of historical experience. 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.

D3.4 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 mortality level uncertainty is nothing more than the effect of a possible mistake in estimation. One reason for this possible “mistake” is the volatility in historical observations. Another reason is that data are almost always out of date.

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 mortality level uncertainty is that the risk capital can sometimes be determined only in the last year of the period studied. 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 to 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 population mortality or an industry (reference) table:

$$f_{be} = \frac{\mu_{obs}}{\mu_{ref}}$$

In the mortality level uncertainty we reproduce the uncertainty in the observations μ_{obs} by

means of an adjustment factor: $f_{ec} = \frac{\mu_{obs} \pm unc_{ci}}{\mu_{ref}}$

with unc_{ci} representing the uncertainty at the confidence level ci :

$$unc_{ci} = \sigma(s_{ci} + t_{ci}\gamma)$$

The factors s and t depend on the time horizon and confidence level, as indicated in Table D.12:

Table D.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

$$N = \text{numbers of policies in the available dataset}$$

$$\sum_j N_j = \text{total number of policies used over the entire observation period.}$$

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 for annuities and a 10% increase for term insurance. The reason for using this assumption is that we do not 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.

D4 Other items

The 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 unfavourable 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 probably product related factors. Further investigation is also needed for this factor.
5. **Diversification** (see Section 7.3 and Appendix E for a discussion)

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 the example in Appendix D1, there is a portfolio of payout annuities. Such a portfolio will diversify more effectively in an entity with, on average, a negatively correlated risk with the portfolio being assessed (e.g., through term insurance or endowments, particularly those on similarly-aged lives) and less effectively in an entity that has already a majority of positively 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 D.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 is needed 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 (e.g., 6%).

Appendix E – Diversification

The objective of this appendix is to provide additional insight into the topic of diversification, as discussed in Section 7.3. Note that diversification, pooling and offsetting all involve the combination of risks. The distinction between them is that diversification involves a combination of dissimilar risks (diversifying risks), pooling involves a combination of similar risks (pooling risks), and offsetting involves risks that are negatively correlated. The mathematical treatment of these mitigation techniques is identical. The proposed calculation methods can be applied both to intra-portfolio (pooling, if the risks within a portfolio are relatively homogeneous) as well to inter-portfolio diversification. E1 provides a discussion of general theory regarding diversification. E2 follows with a description of various technical approaches. E3 discusses the concept of marginal diversification, along with an example.

Much of the following discussion is also applicable to offsetting and hedging, which can be distinguished because they involve negative correlation.

E1 Some general theory and thoughts

Diversification is a critical risk mitigation feature in insurance business and it underlies many important risk management processes. Diversification can exist because of:

- The application of the law of large numbers, to the extent that the risks involved are homogeneous;
- Offsetting (sometimes referred to as *opposite*) risks;
- Independent (sometimes referred to as *unconnected*) risks; and
- Risks that are less than 100% interdependent.

The combination of risks that are not totally dependent of each other results in the diversification effect: the total risk measure (e.g., VaR, TVaR and standard deviation) for to the combination of sub-risks is equal to or less than the sum of the risk measures for each sub-risk.

To the extent that the risks are homogeneous, pooling will usually first be incorporated in the models used to calculate risk distributions. For example, claim frequency is often modelled using a Poisson distribution. In this case, the standard deviation of the number of claims is the square root of the expected number of claims, and the coefficient of variation (standard deviation divided by mean) will decrease in inverse proportion to the square root⁹⁶, as the expected number of claims increases. When combining two portfolios, a recalculation of the total distribution based on the total of the two portfolios has the same effect as the use of diversification techniques to combine the distributions of each of the portfolios.

The diversification effect can be calculated at several levels:

1. between sub-risks within a risk type;

⁹⁶ This inverse square root relationship applies generally to the combination of independent, identically distributed risks and is not a function of the probability distribution.

2. between risk-types within a modelled block of business, for example, a single line of business or business unit; or
3. between contracts or risk types of different lines of business and/or business units.

E2 Technical approaches

The *Blue Book* indicated that the use of copulas is the theoretically correct method to calculate diversification effects in the context of risk margins and required capital. Indeed, in general, the use of a “standard” correlation matrix is inappropriate. The reason for this is that correlation coefficients reflect an average over the whole range of possible outcomes, while risk margins are more concerned with unfavourable outcomes, where the dependencies are often atypical. Copula functions have the advantage that they can be used to accurately combine distributions that are not from the “normal family”. They can also recognize dependencies that change in the tail of the distributions used, for example by the use of a T-Copula.

Severe incidents can impact risks that are normally independent. For example, normally market risk and mortality risk are independent. But if a severe pandemic like the Spanish flu were to occur, with millions of deaths worldwide, this would certainly have economic consequences and impact market risk, for example, equity risk. In practice, it should be remembered that when several distributions are combined, dependency in the tails is likely to be greater the nearer the means of the distributions. In contrast to the failure of a standard correlation matrix to handle this type of situation, copula functions can be used.

However, copula functions can be rather complex to apply, particularly if a large number of distributions have to be combined. A practical solution can be to adjust the correlation matrix in such a way that, for 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 and the use of copula functions can be found in the Diversification paper of the Groupe Consultatif (2005).

E3 Marginal diversification

This appendix section describes a practical approach that has been taken to estimate the effect of diversification that is called “marginal diversification”. If the risks involved with insurance contracts were uncorrelated with each other, the sum of the diversification effects would be additive; however, they are not. In addition, the diversification effect of adding successive risks depends on the order in which they are added.

The marginal diversification approach begins by determining the marginal diversification effect of each risk, assuming that each risk is the last one added to the portfolio. Since the sum of these effects is likely to be less than the total, possibly by a significant amount, an adjustment has to be made. The manner in which the effect of diversification is calculated for the purpose of determining a risk margin under a market-consistent or a current exit value attribute depends on the characteristics of the entity assumed to take over the business whose liability is being measured. The following are three possible approaches:

1. The entity to which the business would be transferred is an empty entity. This assumption was made in Solvency II in the QIS 4 calculations and corresponds to the assumption that, in addition to pooling effects, apart from the diversification that is available to any market participant (e.g., through reinsurance), only diversification within the portfolio is recognized. In other words, there is no other portfolio within the entity over which diversification can be obtained.
2. The entity to which the business is transferred is identical to the reporting entity. This implies that the marginal effect of diversification for the portfolio would be based on the risk profile of the reporting entity (i.e., how much would capital have to increase were this portfolio added to the reporting entity).
3. The entity to which the business would be transferred is a made-up entity that is large and already well diversified, with a risk profile characteristic of the industry in the applicable jurisdiction. In this case, marginal diversification could be based on standard factors set by the regulator or as usual in that area.

The relative diversification effect associated with approach 1) is less than or equal to that of 2), as it lacks the ability to diversify with the risks of other portfolios of the entity. The diversification effect of 2) relative to that of 3) depends on the characteristics of the transferee under 3), but since the entity as described is already well diversified, it is likely that its effect will be lower. The relative effect depends on the risk profile of the entity whose liability is being measured relative to that of the portfolio of the entity to which the transfer is assumed to be made.

In the method described above, the diversification effect can be estimated for a given portfolio. For example, in the VaR approach, the diversification effect can be calculated for a given portfolio for which the specified quantile for the liabilities is desired.

If an exit value is being estimated using the cost of capital approach, the marginal effect of the portfolio on the (economic) capital of the entity that takes over the obligations is needed. Because of diversification effects within the transferred portfolio and between the transferred portfolio and the already existing portfolio, the increase in the capital needed by the entity will not only be less than the level for the transferred portfolio ignoring diversification within it, but also less than the capital required for the transferred portfolio allowing for that diversification.

A simple example of approach 3) follows that illustrates how it might be applied in practice.

Suppose there is a portfolio with a capital of 1,000. 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 added 100).

If the two portfolios are not independent of each other, 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 added 100).

These estimated impacts for each of the risk types are shown in Table 6.11. 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 in some cases a compromise approach might be appropriate, especially for regulatory purposes: the use of risk “buckets”. In it, 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 the 50% bucket, etc. One characterization is shown in Table E.1. This process includes rounding in which some additional margin is created. If the transferred portfolio creates more diversification for a certain entity, the Bucket system leads to a somewhat conservative margin, and the other way around.

The reason for using the Bucket system is that it can be difficult to define a unique, well diversified insurer. It is the goal of this system to reflect the diversification effects of most insurers. In the Bucket system it is less important to define the reference entity.

Table E.1 Classification of diversification effects

Level of diversification	Capital after diversification
Full	0%
High	25%
Medium	50%
Low	75%
None	100%

An example of an allocation of the types of risks shown in Table 6.11 to the buckets could be as shown in Table E.2 (note that this table includes life, health and property and casualty risks).

Table E.2 Ordering of risk types

Risk type	Buckets	
	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 in Table C.2 are not recommendations of the RMWG; rather, they are included for illustrative purposes only.

In the above table all volatility risks are set at 0, since volatility risk within a risk type is assumed to be largely controllable through pooling. Alternatively, they could also have been assigned a relatively small value (e.g., 25%)

Appendix F – Research Recommendations

During the development of this paper, the following areas for further research have been noted. They are categorized by topic, as several relate to more than one section of the paper.

General measurement and data

1. Development of educational guidance regarding the application of stochastic models in the derivation of current estimates and risk margins.
2. Development of guidance on assessing the reliability and auditability of data. (Sections 3 and 4)
3. Further research on the reliability of market-based information. This is not only important in the context of the current financial crises but also in overheated markets. (Sections 4, 5 and 6)
4. Further research on approaches that may be used to promote consistent measurement of assets and liabilities. (Sections 3, 4, 5 and 6))
5. Further research on the development of probability weighted estimates of cash flows, including conditions of multiple risks, the selection of scenarios and methods to approximate a full probability model. (Sections 4 and 6)

Extreme events (Sections 4, 5 and 6)

1. Further research on methods of incorporating low probability, high severity events that have a high degree of uncertainty.
2. Further research on the dependencies of such events (e.g., an earthquake triggering a fall in equity markets)

Discount rates (Section 5)

1. Further research on alternative risk-free rate methodologies and sources of information.
2. Further research on methods and sources of information to reflect liquidity in discount rates applied to the measurement of liabilities.
3. Further research on approaches to discounting when the obligation of an insurance contract is expressed in terms of the performance of a designated set of assets.
4. Further research on consistency of approaches to determining discount rates across types of contracts, instruments and (pension) programs, including consistency between “risk-free” and “linked” approaches (items 1 and 3 above)

Risk margins methodologies (Section 6 and 7)

1. Further research on methodologies for setting parameters for the methodologies, including:
 - a) For quantile approaches, the level of quantile appropriate for the risk margins and how to assess this level for different product types and over time.
 - b) For cost of capital approaches, the methodologies underlying the development of cost and capital in the cost of capital method.
2. Further research on the basis for and methods of incorporating shape and time elements of risk measures.
3. Further research on methods of incorporating risk perception and risk preference and changes in them in risk margin methods.
4. Exploration of approaches to determining risk margins other than the ones discussed in this paper, for example, those using utility theory or hazard transforms.
5. Further research on consistency in setting risk margins gross of ceded reinsurance, net of ceded reinsurance and the reinsured part of a liability.
6. Further research on the measurement of the effect of contract adaptability, discretionary benefits and asset/liability management on risk margins. (Sections 7.6 through 7.8)

Diversification

1. Further research on the effect of risk concentrations on risk margins (Sections 6 and 7.9)
2. Development of guidance on the use of copulas for assessing diversification benefits in current estimates and risk margins (Sections 4 and 6)

Other items

1. In the implementation of a no-gain at issue accounting standard, exploration of approaches that can be taken to the release of the premium margin over time. (Section 8.2)
2. Further research on methods that should be considered in the measurement of non-performance risk in insurance contracts. (Section 8.3)
3. Further research on appropriate governance models. (Section 8.5)

Tables and Charts

5.1	Decomposition of sterling-denominated investment-grade corporate bond spread.....	43
5.2	Estimated relative contribution of different elements of the spread between A rated bonds and U.S. Treasuries.....	44
5.3	Variation in European government bond yields	47
5.4	Variation in European government bond yields in 2008 and early 2009.....	47
5.5	U.S. corporate bond credit spreads 1997 – 2003	49
5.6	Average term structure of swap spreads (January 1997-July 2005)	51
5.7	LIBOR compared with repo rates.....	52
5.8	TED spread.....	53
5.9	U.S. bond credit spread.....	53
5.10	Possible bases for discounting	55
6.1	Assumptions used for risk margin examples	75
6.2	Risk margins at selected confidence levels Number of standard deviations*	76
6.3	Risk margins at selected confidence levels Risk Margin as % discounted current estimates	77
6.4	Capital at selected confidence levels Number of standard deviations	80
6.5	Capital at selected confidence levels Capital as % of discounted current estimate	81
6.6	Cost of capital calculation for Product B (Motor)	83
6.7	Cost of capital sensitivity tests Risk Margin as % of discounted current estimate.....	83
6.8	Discount related risk margin methods Risk margin as % of discounted current estimate.....	85
6.9	Source of risks in different risk margin methods.....	87
6.10	Comparison of risk margins from different methodologies Risk margin as % of discounted current estimate	89
6.11	Summary of risks reflected in the risk margin	93
6.12	Risk context options	96
6.13	Comparison of risk margin methods Compliance with the five IAIS characteristics.....	105
6.14	Comparison of risk margin methods Compliance with additional RMWG characteristics 1-3.....	106
6.15	Comparison of risk margin methods Consistency between classes of business.....	107
6.16	Comparison of risk margin methods Ease of Calculation.....	108
6.17	Comparison of risk margin methods Market-consistency.....	110
6.18	Comparison of risk margin methods	110
C.1	Coverage and runoff periods Discounted current estimates at the beginning of the year	163
C.2a	Probability density functions for distributions with gamma 0.0 (normal) and 0.20, 0.40, and 0.80 (Products A-C).....	165
C.2b	Probability density functions for products A-C	165
C.3	Cumulative probability functions — various levels of skewness	166
C.4	Risk margins as % of discounted current estimate	169

C.5	Comparison of a lognormal distribution and the normal power approximation at selected skewness (gammas)	170
D.1	Risk margin comparison	176
D.2	Release of risk margins over time with consistent initial values	177
D.3	Risk margin based on cost of capital of a AA rated entity	178
D.4	Risk margin based on 75% quantile.....	179
D.5	Risk margin comparisons with consistent initial values single premium annuity	180
D.6	Diversification effect	181
D.7	Cost of capital method based on an AA rated entity term life insurance.....	181
D.8	Quantile method based on 75% quantile term life insurance	181
D.9	Risk margin comparison with consistent initial values term life insurance	182
D.10	Risk margin release over time with consistent initial values term life insurance.....	183
D.11	Number of standard deviations needed in a Student's t Distribution	184
D.12	s and t values.....	186
E.1	Classification of diversification effects.....	192
E.2	Ordering of risk types	193

Glossary

Asset. "The future economic benefit embodied in an asset is the potential to contribute, directly or indirectly, to the flow of cash and cash equivalents to the entity. The potential may be a productive one that is part of the operating activities of the entity. It may also take the form of convertibility into cash or cash equivalents or a capability to reduce cash outflows." [IFRS *Framework for the Preparation and Presentation of Financial Statements* 53]

Assumption. An estimate of a measurement input. It is an input parameter used in an estimation model to measure actuarial items, such as a liability for an insurance contract or the economic capital for an insurer.

Asymmetry. The extent to which a probability distribution deviates from a symmetric form (i.e., in a form with equally weighted sides around the mean).

Best estimate (also see *current estimate*). Usually refers to the 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 other contexts, it can refer to the most likely outcome or can 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. It is 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* or *TVaR*)). 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 amount of return, in addition to the amount earned by the insurer from its investment of its capital, that the market would require for taking on a given level of non-hedgeable risks.

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. (see Section 6.5.2)

Credibility. In actuarial literature, it is the extent that a given set or sets of information can be used or relied upon for the purpose of estimation. In its application, information from a specified source of information (or current assumption) 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 probability-weighted estimate of a set of future cash flows, considering all currently available information, discounted for the time value of money.

Discontinuance rate (also referred to as *surrender rate*, *lapse rate*, or *contract 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 dissimilar risks (sometimes resulting from a set of obligations and rights) of two portfolios in a manner that results in a lower amount of risk than the sum of the risks for the separate portfolios. The extent of this difference is greatest if the correlation between the risks is low. Because diversification within a portfolio of similar, largely uncorrelated risks is taken for granted, discussion of diversification is usually restricted to diversification between portfolios.

Diversifiable risk. A risk is diversifiable if it can be reduced, theoretically to zero, by diversification.

Economic capital (see *capital*).

Economic value. A value that can be expressed in economic terms. Uncertainty has economic value if entities are prepared to pay to reduce (e.g., insurance) or increase (e.g., gambling) it.

Estimate. A number derived to represent an uncertain quantity, when exact measurement is not possible.

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.

Expected value (also referred to as a *mean value*). An estimate of a probability weighted value. Although it can be derived through stochastic models, other methods can be used.

Explicit assumption method. An approach used to estimate risk margins included in the measurement of a liability in which margins are explicitly estimated for each major assumption under risk. (see Section 6.5.4 for details)

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]

Faithful representation. Information that is complete, neutral and free from material error and depicts the economic substance of the underlying transaction, event, or circumstance. [IASB *Conceptual Framework* Exposure Draft, QC7]

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 and casualty insurance* or *non-life insurance*). Insurance covering property, personal injury 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. A promise that an obligation that will be fulfilled that is not subject to an option of the insurer (if provided by an insurance contract) nor directly upon the experience of the guarantor.

Hedgeable risk. 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 replicating 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. For 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.

IAIS. International Association of Insurance Supervisors.

IASB. International Accounting Standards Board.

Liability. Either a synonym for the term "obligation", that is reflecting a legal relationship of one entity to another party causing duties to be performed by the entity or a term reflecting the measurement of an obligation for reporting purposes mainly from an accounting perspective.

(In IAIS and some regulatory contexts this second meaning is also referred to as a *technical provision, contingent liability* or *actuarial reserve*). 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] From an accounting perspective, sometimes synonymous with the amount equivalent to the net obligations and rights associated with a specific relationship between one party and another, usually of a legal, regulatory, contractual or constructive nature.

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 indicating the extent to which its owner can convert it to cash or cash equivalent when called upon. For a liability, it is the degree to which the bearer of the liability can be required to settle the obligation at short notice.

Loss adjustment expense (also often sometimes referred to as *claim settlement expense*). Expense of an insurer associated with the management or defence of its obligation for claims made under an insurance contract.

Margin over current estimate (*MOCE*, also see *risk margin* and *service margin*). A margin included in a liability or asset in addition to the current estimate, usually determined explicitly.

Market-based. Derived from observed transaction prices from a market.

Market-consistent assumption. A pricing input to measurement that is market-based.

Market-consistent

- **in practice.** Based on assumptions and approaches that are used and is sensitive to change in the market to the extent observable

- **in theory.** Based on assumptions and approaches that a market participant would use and is sensitive to changes in the market to the extent observable.

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*]

Matching portfolio (see *replicating portfolio*).

Measurement. The process of determining or estimating a value, often a financial value.

Measurement date. The date as of which values are measured, in contrast with the date on which the calculations take place.

Minimum risk portfolio (see *replicating portfolio*).

Mitigation. A reduction in losses or risks.

Non-market assumption. An assumption that refers to items other than prices in a market, such as mortality rates in the case of life insurance contracts.

Normal distribution. A probability distribution that 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 a legal or regulatory requirement. 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 for the Preparation and Presentation of Financial Statements*, 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, 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 a contract. Includes implied options, such as the option to stop paying premiums under an insurance policy.

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 behaviour. Selection by a policyholder of an available option within a contract.

Policyholder bonus (also referred to as *bonus* or *policyholder dividend*). The amount paid or credited to a policyholder by an insurer under 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. In certain other contexts, the concept of pooling has been used to also include those contracts or risks with dissimilar risk exposures.

Portfolio. A group of similar items managed in combination.

Present value. The value of one or more future cash flows, discounted to reflect the time value of money, measured as of a specified point in time.

Probability (also referred to as *chance*). A way of expressing knowledge or belief that an event will occur or has occurred. In mathematics, the concept is given an exact meaning in probability theory. Probabilities range from 0 to 1.

Probability density function (*PDF*, also referred to as a *probability distribution*). 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* that 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 for a portfolio of risks, as a result of random variation between the individual elements of that portfolio, as distinct from systemic or systematic risk that affects the portfolio as a whole. It can refer either to the variation of those elements or to the resulting proportionately reduced variation of the portfolio. It can be measured before or after risk mitigation techniques are applied.

Quantile method. Any one of a family of methods in which the risk margin is expressed directly as a function of the probability distribution. This term can be used to refer to a specific member of this family, also known as value-at-risk (*VaR*) or a *confidence level method*, in which the risk margin is the difference between a specified quantile (percentile) of the distribution and the expected value. (see Section 6.5.1 for details)

Reference entity. A hypothetical large, well diversified and financially secure entity that is used 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]

Relevant information. “Information that influences economic decisions of users by helping them evaluate past, present or future events or confirming, or correcting, their past evaluations.” [IASB *Framework for the Preparation and Presentation of Financial Statements*, 26]

Reliable. “Information has the quality of reliability when it is free from material error and bias and can be depended upon by users to represent faithfully that which it either purports to represent or could reasonably be expected to represent.” [IASB *Framework for the Preparation and Presentation of Financial Statements*, 31] Uncertain information can be reliable, if it reliably reflects the uncertainty in what it represents.

Replicating portfolio to an insurance liability (also referred to as a *minimum risk portfolio*). A portfolio of assets providing cash flows that exactly match the cash flows from the liability in all scenarios. Its aim is to appropriately reflect the value of the options and guarantees in the contract in establishing a discount rate. In practice, in the context of insurance, it is a portfolio of assets that minimizes the variation between the asset and liability cash flows across all scenarios. Replicating assets can include all types of traded instruments, including financial options. Hence, in this context, a replicating portfolio reflects the effects of contractual options and guarantees on the cash flows, but may not fully replicate the impact of other risks. Unreplicated liability risks are allowed for outside the discount rate.

The replicating portfolio concept is closely related to other concepts, including those of a minimum risk portfolio and a matching formula, as can be seen in the following:

A *minimum risk portfolio* is a portfolio of assets that minimizes the variation between asset and liability cash flows, across all scenarios. Its aim is, as far as possible, to reflect the uncertainties

in the contract outcome, in establishing a discount rate. This is a slightly different concept from replicating portfolio, since it explicitly accepts the possibility of approximate replication of duration, option and guarantee effects. In practice, in the context of insurance, the two terms are synonymous. Other liability risks are allowed for outside the discount rate.

A *matching portfolio* is a notional portfolio of “risk-free” fixed interest assets providing cash flows that exactly match the expected cash flows from the liability. Such a portfolio eliminates any gain or loss from interest rate movements and can be used to establish risk-free discount rates for the portfolio, but does not respond to features, such as options, guarantees and insurance risk, that give rise to potential departures from the expected cash flows. These other liability risks are allowed for outside the discount rate. The term is also used for an investment strategy that seeks to minimize interest rate risk with assets that approximate the expected liability cash flows.

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] An exposure to adverse consequences. It is also used more generally to include both risk and uncertainty. In insurance, risk is also used to refer to the subject of an insurance policy, as in an *insured risk*.

Risk concentration. The extent to which an entity is exposed to a particular risk or type of risk.

Risk diversification (see *diversification*)

Risk margin (also referred to as *margin over current estimate*). The portion 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 ad hoc task force of the IAA, initiated in 2005, to respond to a request of the IAIS.

Risk mitigation technique. A risk management approach that reduces a risk borne by the entity.

Service margin. A margin over current estimate, relating to services provided through a contract, other than a risk margin or margin for financial risk, included in the measurement of a liability if market participants would be expected to require such a margin for the service to be provided.

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, for example, 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 (also 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 understood, the model used might be incorrect to some degree and/or the actual model parameters will vary from the estimated parameters.” [IAA Blue Book]

Unit of measurement (also referred to as *unit of account*). The level at which the liability is aggregated (or disaggregated) for purposes of applying a measurement standard or approach. It might be a group of similar obligations (or assets) or an individual obligation.

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