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MEASUREMENT OF LIABILITIES FOR INSURANCE CONTRACTS: CURRENT ESTIMATES AND RISK MARGINS

_____ __, 2007

Prepared by the ad hoc Risk Margin Working Group

Comments to be sent to katy.martin@actuaries.org **by ___ __, 2007**

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1. Executive Summary

[to be completed prior to subsequent exposure]

2. Objectives of paper

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

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

The background leading to the formation of the RMWG is described in Appendix F1, its Terms of Reference is given in Appendix F2 and the process it has followed in the development of this paper is outlined in Appendix F3 of this paper.

As outlined in Section F2.3, the objectives of this paper are focused on information that it hopes will prove useful in both regulatory and general purpose financial reporting in the following areas:

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

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

Although this paper includes a description of certain current approaches to key aspects of the measurement of liabilities for insurance contracts, it is not an exhaustive source of these practices, nor indeed does it address the wide variety of current types of contracts offered globally in the insurance marketplace. As a result, it is not intended to provide a comprehensive survey or identify the single best method, in part because different circumstances, types of contracts and insurance claims will be best measured by different actuarial techniques. In many cases, more than one method may be acceptable, depending on the financial reporting standards and circumstances that apply.

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

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

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

- An introduction and context for measurement is provided in Section 3.
- Discounting bases and considerations are discussed in Section 4.
- Considerations in developing expected cash flows are discussed in Section 5. Note that some of these considerations also apply to the developing of estimates of risk margins considered in Section 6. A further discussion of probability distributions, given in Appendix A and specific assumptions/inputs are given in Appendix E.
- A discussion of the objectives and methodologies that can be used in estimating risk margins are given in Section 6, with additional examples in Appendix B.
- Other factors that should considered in the measurement process, particularly regarding mitigation techniques associated with insurance contracts are principally discussed in Section 7, although treatment of some of the techniques are also covered in Section 6 and Appendix C.

3. Introduction to measurement

3.1 Purposes of measurement

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

- Calculating financial reporting and regulatory values
- Capital assessment for both regulatory compliance and economic capital assessment and allocation
- Pricing and product management
- Strategic planning and financial management
- Merger and acquisition analysis
- Development of performance metrics and internal management reporting.

Although the basis for values used in these functions have varied by application and jurisdiction, some fundamental principles are common to all. In some areas they vary, in some cases significantly due either to the specific context and requirement in which they are developed. As described in Section 2, this paper's focus is on values generated for financial reporting and regulatory purposes. Note that even in these limited areas, historically a wide range of principles and rules apply. As a result, it is difficult to derive a single approach for these measures. For instance, measures developed for solvency related purposes may or may not generate different values for general purpose accounting. Nevertheless, methods used to derive these measures for various purposes have continued to gradually converge over time.

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

3.2 Standard setter developments

Significant discussions regarding the development of a revised framework for the financial reporting of insurance contracts are currently underway for both general and regulatory purposes. As part of that process, the IASB exposed for comment its Preliminary Views on Insurance Contracts, part of Phase 2 of its project on accounting for insurance contracts. These Preliminary Views propose an exit value approach, which, in the absence of a sufficiently active and relevant market for the insurance contracts to

observe these values, takes a prospective view at the reporting date that reflects the amounts required for the insurer to transfer the rights and obligations of the insurance contracts. It is anticipated that some of the concepts involved in Phase 2 will likely continue to evolve in the near future as the IASB moves toward the exposure draft and adoption stages of their project.

Separately but not completely independently are developments by the International Association of Insurance Supervisors (the "IAIS"). The IAIS's *Second Liabilities Paper* (2006) has potentially moved the IAIS' regulatory reporting on a path toward accepting many, if not all, of the principles underlying liability measurement of a general purpose reporting nature, including its current exit value approach.

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

Regulators are also concerned with the level of surplus a company maintains. Both reporting systems have differed considerably around the world, resulting in financial reports that some have viewed as being non-comparable and opaque in nature. The current movement in both areas is to enhance reporting and converge national standards by producing financial statements that are consistent, transparent and representative of the entity's actual performance.

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

insurance contracts[2], a risk margin and where applicable, a service margin.

General types and concepts of probability distributions are given in Appendix A, the general characteristics of which are used in several parts of the paper. Current estimates are discussed in Section 4, with a detailed description of specific current estimate assumptions in Appendix E. Discounting is discussed in Section 3. The role of and approaches to the measurement of risk margins are discussed in Section 6, with additional risk margin examples given in Appendix B. Section 8.1 includes a discussion of service margins.

The IAIS has expressed the view that:

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

This view was expanded upon in the following:

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

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

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

As noted above, key members of the RMWG participated in the development of the IAIS's *Second Liabilities Paper*. Other RMWG members were involved in IASB working groups such as the Insurance Working Group and the Financial Instruments Working Group, as were key IAIS subcommittee chairpersons.

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

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

The conclusions as expressed (slightly altered to recognize that underwriting risk involves both insurance and related risks and service risk in general purpose financial reporting parlance, as well as the effects of concentration risk as ameliorated by risk mitigation activities) are still generally viewed as appropriate by the RMWG and are given in Table 6.12. The adoption of these assignments may help to remove many (but not all) of the obstacles that might inhibit the IASB and the IAIS from using the same methodologies for measurement of liability of insurance contracts.

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

While risk margins and capital both relate to providing for risks inherent in insurance contracts and in an insurance entity, they do not serve the same objective. Capital aims to ensure that an entity has sufficient financial resources to withstand a significant adverse deviation such that the entity

is able to satisfy its obligations to its policyholders. Hence, capital protects the liabilities, while risk margins can be seen to provide for the cost of bearing risk and provides a confidence level around the current estimates. See section 6.1 for a more complete discussion of this.

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

Solvency issues are outside the scope of this paper, although to properly discuss some of the issues relevant to the measurement of liabilities of insurance contracts, the context of the total balance sheet in which they reside and the inter-relations between the treatment of risk between liabilities and capital are discussed where appropriate.

A key proposition expressed by the IASB has been that the assets held by an insurer should not affect the measurement of the liabilities of insurance contracts, unless the obligations underlying the liabilities change as a result of holding those assets. This financial reporting proposition is directly addressed by addressing asset credit risk and market risk factors outside of the measurement of liabilities. It suggested that only the credit risk and market risk that cannot be replicated in the market (i.e., unhedgeable risk) should be reflected in liabilities. All such risks should be addressed in a regulatory solvency regime through “total balance sheet resources."

The recommended recognition of risk mitigation techniques in the *Blue Book* may not be totally consistent with current accounting thinking. Section 7 deals with risk mitigation and related issues, including the treatment of the effect of pooling and diversification.

The IASB Board’s tentative thinking about product adjustability including policyholder rights also may differ from the recommended technique. This topic is further dealt with in Section 7.5, focusing on participating policyholder dividends / bonuses and non-guaranteed contract features.

4. Discounting cash flows

4.1 Introduction

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

Current bases for discount rates differ, in some cases dramatically, depending in part on the financial reporting requirements and objectives under which the discounting is being conducted and contract type involved. Discount rate bases used to measure the present value of expected 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). Often, discount rates depend on the duration of the cash flow being discounted.

In most cases, discount rates will be based on whether a contract's obligation is:

- not directly linked to the actual portfolio or contract specific asset performance, relate to the timing, currency and liquidity of the expected cash flows will be applied, possibly based on a replicating portfolio or
- directly linked to a desgnated portfolio of assets or contract-specified asset performance, be the expected future investment return net of expected investment expenses and default costs (linked rates).

Three possible sources of unlinked discount rates that might be appropriate are high quality government bond rates, swap rates, or high quality corporate bond rates, possibly with an adjustment for expected default risk if relevant.

In any event, these discount rates will be associated with the expected timing of the associated expected liability cash flows (i.e., yield curve specific). In cases in which discount rates have limited influence on the liability cash flows of insurance liabilities or if there is a relatively flat yield curve, a single average discount rate can be used, depending on materiality considerations. If used, such an average discount rate would ordinarily be determined so its application results in a liability similar to what would be obtained by using the complete yield curve and may need to be reviewed on a regular basis to ensure that its effect remains similar to that of the relevant yield curve.

If there are no relevant observable investment return rates, then the most similar available yield curve or interest rates would usually be used. For example, if there is no market in which risk-free securities are traded in a jurisdiction from which to observe yield rates at a particular duration (especially in a jurisdiction where such securities are not available at a duration as long as the expected insurance cash flows), then the closest available securities are usually used (unless applicable financial reporting context or standard provides different guidance). For example, for a cash flow expected in 30 years and the longest dated available bond is 20 years, the interest rate for the 20 year bond is sometimes used for practical purposes. Nevertheless, it may not be appropriate in all circumstances. Note that financial models exist that can be used to extend the bond yield curve, e.g., through Hull-White. Alternatively, rates beyond 20 years can be treated as unhedgeable risks and thus it would be appropriate to consider this risk as part of a risk margin. If done appropriately, either approach would lead to a consistent estimate and a market-consistent base for discounting purposes.

Although not applicable to discounting, expected total investment returns can be significant in the measurement of liabilities for insurance contracts, for example, in deriving the cost of certain contract guarantees. A discussion of models, especially those involving future yields on equity instruments, are outside the scope of this paper. In the application of certain accounting standards, mean-reversion models have been used, although they are not considered to be market-consistent. Possible alternative approaches include the use of long-term bond assumptions or long-term market-based assumptions based on market expectations or long-term experience.

In the remainder of this section we discuss the following conceptual aspects relating to the choice of interest rate to be used to measure the liabilities of insurance contracts:

- Risk-free rates
- The liquidity premium that might be added to the risk-free rates
- An allowance for non-performance (credit characteristics of the obligation or own credit standing).

4.2 Risk free discount rates

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

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

4.2.1 Government *bond rates*

Government bond yields usually are the most prudent basis for risk-free yields and, from a practical perspective, the only measure that is directly observable without needing further adjustment.

The disadvantages of a pure Government bond yield measure include:

- Limited number of outstanding terms for long-dated Government bonds, so there may only be a few points from which to base the long-end of the yield curve.

- Government bond prices can be distorted due to an artificially high demand from financial institutions and pension funds that may be subject to regulatory constraints that favor Government bond holdings. These supply and demand distortions are not a characteristic of the liabilities.

- There may not be a liquid government bond market, particularly in those jurisdictions in which the government has run a surplus.

4.2.2 Government bond rates plus adjustment

The rationale for adjusting Government bond yields is to eliminate market distortions that are not relevant to the insurance liability.
The most commented-on distortion is the short supply of Government bonds at the long end of the yield curve. However, it is very difficult to quantify and to make an adjustment for this effect. In fact, an example of an investment strategy that failed due to this lack of supply was Long Term Capital Management.

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

> "Government bond sale and repurchase ("Government bond repo") transactions involve the temporary exchange of cash and

> Government bonds between two parties; they are a means of short-term borrowing using Government bonds as collateral. The lender of funds holds government bonds as collateral, so is protected in the event of default by the borrower. General collateral (GC) repo rates refer to the rates for repurchase agreements in which any Government bond stock may be used as collateral. Hence GC repo rates should, in principle, be close to true risk-free rates. Repo contracts are actively traded for maturities out to one year; the rates prevailing on these contracts are very similar to the yields on comparable-maturity conventional Government bonds."

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

This view is also expressed in UK Actuarial Guidance Note 45 (GN45), paragraph 4.1.3, when developing a "realistic" balance sheet and ICA framework. An earlier version of this guidance note based on a 2004 analysis suggested that repo rates exceed Government bond yields of equivalent term by around 5-10 basis points.

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

In many jurisdictions, the repo–Government bond spread is readily observable and for practical purposes, it should be possible for companies to perform a regular analysis of the GC repo curve.

While this might eliminate an important distortion, the Government bond yield plus measure may often be conservative or prudent due to other nonquantifiable market distortions. It may also 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.

4.2.3 Corporate bond rates minus adjustment

This is an alternative to a 'Government bonds plus' basis. It starts with high-quality corporate bond rates and deducts a margin for default risk (and possible other elements not relevant to the liability), arriving at a

proxy for a risk-free rate. This approach avoids having to eliminate distortions to Government bond yields, especially if a robust corporate bond market exists in the jurisdiction.

Expected defaults are typically based on well-known studies of historic default data. For example, Table 4.1 was developed from Merrill Lynch data for the U.S. market (1997-2003). It shows both the market credit spread and the spread based on expected defaults. Note that the relative difference between the two decreases as the credit rating gets worse and debt gets longer.

Table 4.1 U.S. corporate bond credit spreads

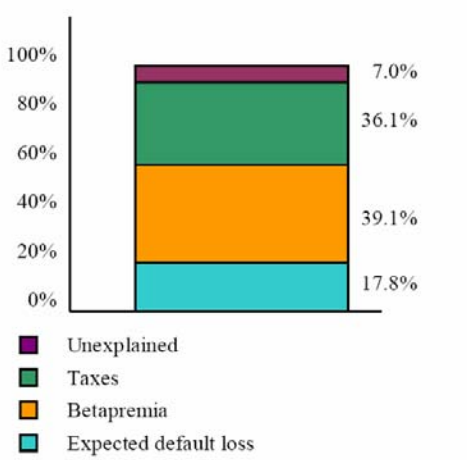
Rating	**=> => Increasing Term to Maturity => =>**							
	Spread	**Exp. Loss**	**Spread**	**Exp. loss**	**Spread**	**Exp. loss**	**Spread**	**Exp. Loss**
AAA	49.50	0.06	63.86	0.18	70.47	0.33	73.95	0.61
AA	58.97	1.24	71.22	1.44	82.36	1.86	88.57	2.70
A	88.82	1.12	102.91	2.78	110.71	4.71	117.52	7.32
BBB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

Values in basis points.

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

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

Figure 4.2 Estimated relative contribution of different elements of the spread between A rated bonds and U.S. Treasuries



Source: Credit Derivatives, Derivatives working party, 2005

The Betapremia is also known as the credit risk premium. It is reasonable to assume that a credit risk premium exists that compensates the investor for the uncertainty associated with actual defaults being different from its expectation. Credit risk is also positively correlated with equity risk and, more generally, with overall drivers of market risk. Hence, this cannot be diversified away and should command a risk premium.

The tax element shown in Figure 4.2 may be specific for the U.S. and not apply in other markets. It relates to a differential tax treatment of returns on government bonds and corporate bonds.

The unexplained element in Figure 4.2 could relate to a number of possible smaller elements including:

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

An additional important element of the spread which was not analysed in the Merrill Lynch study underlying the above figures is the liquidity premium (see section 4.3).

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

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

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

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

4.2.4 Swaps minus adjustment

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

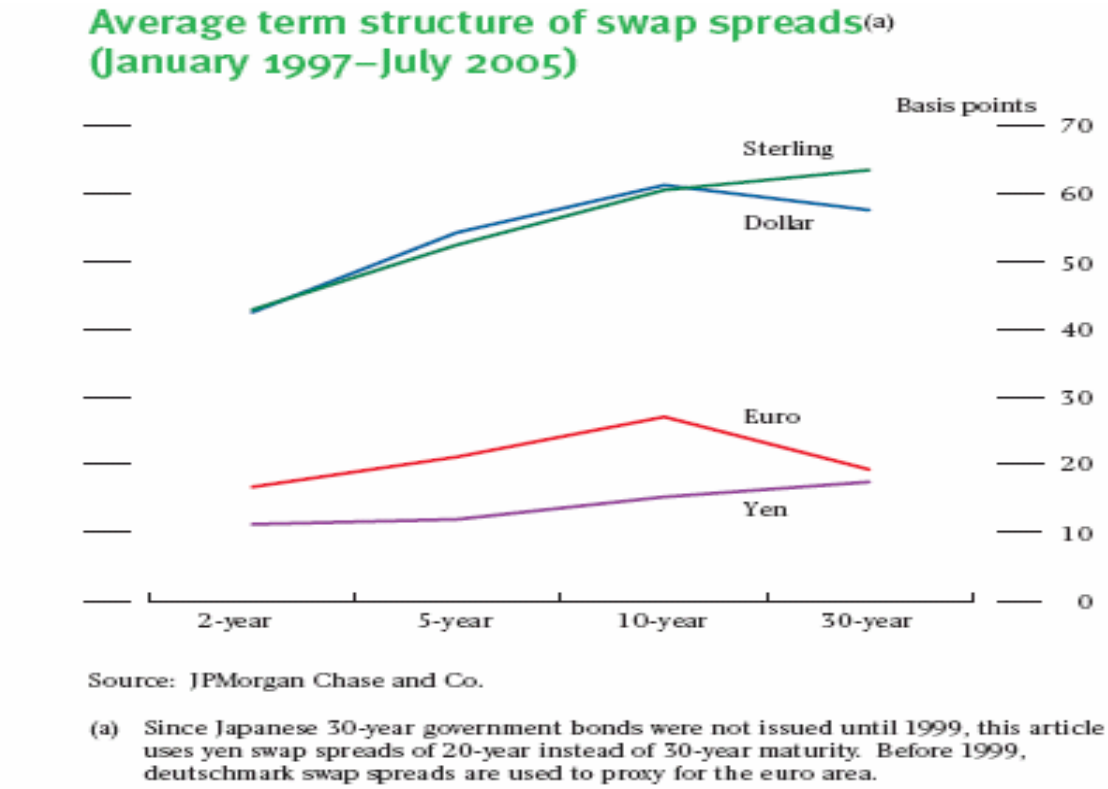
> An interest rate swap contract is an agreement between two counterparties to exchange fixed interest-rate payments for floating interest rate payments, based on a pre-determined notional principal, at the start of each of a number of successive periods. The floating interest rate chosen to settle against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

and their assets, and to hedge long positions in the cash markets. Traded swap contract maturities range from 2 years to 50 years.

In some jurisdictions, the swap market is more liquid than the Government bond market (there is no such market in other jurisdictions), but its main advantage is that this liquidity often extends a lot further than the Government bond market. It may therefore represent a more robust and reliable basis for determining discount rates for long term liabilities.

Figure 4.3 shows average historic swaps spreads over government bond yields.

Figure 4.3



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.

Swaps are over-the-counter (OTC) contracts, primarily transacted between counterparties that are both financial institutions. Swaps do not reflect the credit risk of the parties transacting the swap. Instead, the credit risk of swaps refers to the credit risk inherent in achieving the floating leg of the swap. In order to honour the floating leg of the swap a company would have to deposit the underlying nominal of the swap with another financial institution, which makes this nominal subject to credit risk. This risk

inherent in the floating leg will equally be reflected in the fixed leg of the swap and should be eliminated in any measure for risk-free rates.

Another element of the swap spread that should be deducted from the swap rate is the fact that in practice there are no deposit instruments that earn the six-month LIBOR rates.

In reality, a majority of the swap market is either collateralised or operates through margin accounts that virtually eliminate any risk of non-payment.

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

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

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

Figure 4.5 shows the Government bond (Zero Gilt), LIBOR and GC repo rates in the UK as at end 2005 over a one year time horizon.

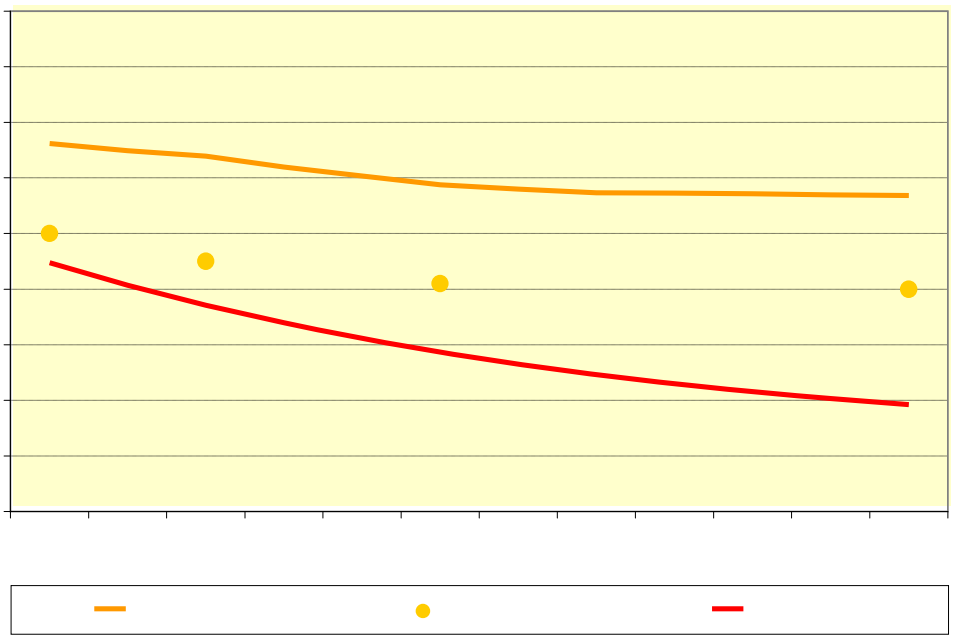


Figure 4.5 shows that, for the relevant six-month LIBOR term, the spread of LIBOR over the GC repo rate is around 20bp.

Recent swap spreads over Government bonds have generally been around 30bp (maturity 10 years). This would imply a spread over Government bonds of around 10bps.

The Bank of England supports the approach of 'swaps minus' as a reasonable way to determine the true risk-free rate. (See for example "Government bond market valuations in an era of dwindling supply", www.bis.org/publ/bispap05e.pdf)

4.2.5 Swap rates

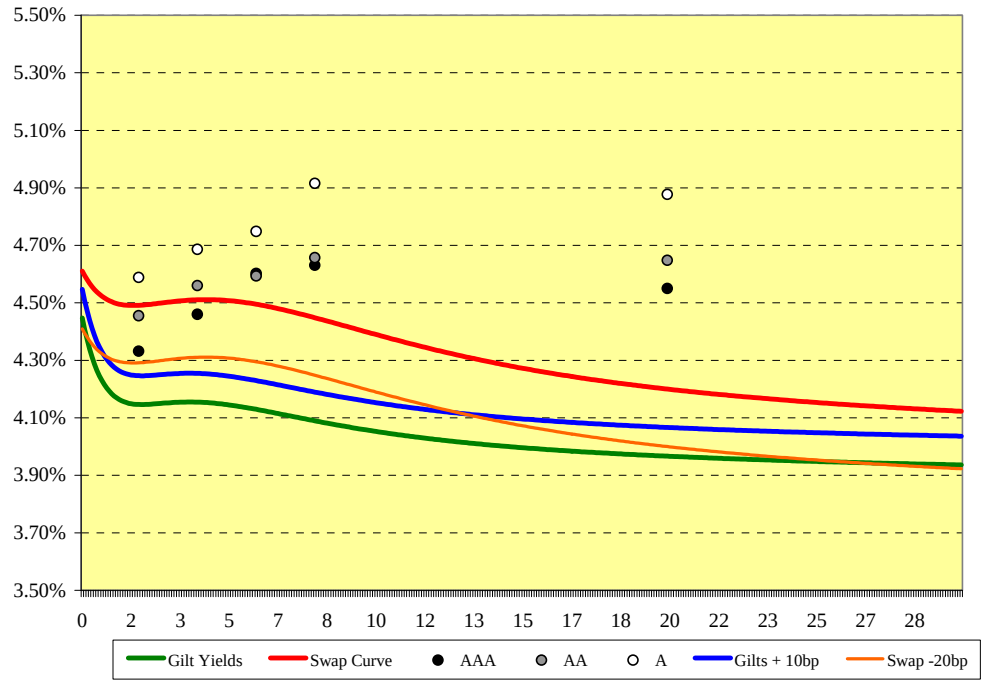
Given the above, it may be difficult to justify unadjusted swap spreads as risk-free. Nevertheless, the CRO Forum has presented this benchmark by indicating that "they are typically the most liquid, complete and reliable risk-free rates available. This is more conservative than using a truly economic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

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

4.2.6 Comparison

Figure 4.6 shows a comparison between the various possible measures discussed above, as at end 2005 over a 30 year term (note that in these graphs gilts refer to Government bonds).

Figure 4.6
Possible bases for discounting
31/12/05



4.3 Liquidity

4.3.1 The liquidity premium

The risk-free rates discussed so far have been risk-free rates that can be earned on highly liquid assets such as government bonds and swaps. To the extent that the liability cash flows are less liquid than these assets, it might be appropriate to use a different set of discount rate to reflect this

(as the replicating portfolio for the cash flows does not need to be as liquid). The following extract addresses this point.

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

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

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

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

Whether liquidity premia should be considered at the level of portfolios rather than individual contracts is thus relevant. On a portfolio basis, the uncertainty of cash flows that exists at contract level is reduced, providing

the insurer an opportunity to earn a liquidity premium, even for contracts with mortality or surrender risk.

For example, annuity payments depend on survivorship, which is reasonably predictable if the portfolio is large enough. Contracts that can be surrendered would be considered less predictable, as the timing of payouts can depend on the policyholder's behaviour and reactions to economic or other events. Again, however, there is some predictability if a large portfolio is involved. Arguably therefore, immediate annuities should be valued using a higher liquidity premium than many savings products that can be lapsed on demand.

4.3.2 Estimating the liquidity premium

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

A recent study by Longstaff, Mithal & Neis (2004)[3] focuses on evidence from the credit default swap market to eliminate a default-related component from corporate bond spreads. They identify a regression relationship between the resulting non-default component and several indicators of liquidity (e.g., bid-ask spreads) on the data set. The average liquidity premia measured range from 50 basis points for AAA/AA bonds to 72 basis points for BB bonds.

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

Other studies based directly on corporate bond data have derived lower estimates. For example, Driessen (2005)[4] estimates a liquidity premium of about 10 basis points for a BBB bond. Li, Shi and Wu (2005) estimate that the liquidity premium explains 25% of the spread for investment grade bonds.

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[3] Longstaff, Mithal & Neis (2004), Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit-Default Swap Market, , www.princeton.edu/~bcf/LongstaffPaper.pdf

[4] Driessen (2005). Is Default Event Risk Priced in Corporate Bonds? *Review of Financial Studies 18, 165-195*

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

One U.S. study directly examines the difference between zero coupon U.S. Treasury yields and yields on identical bonds issued by Resolution Funding Corporation (Refcorp)[5], a U.S. government agency. The article explains that Refcorp bonds literally have the same credit risk as Treasury bonds. However, since Treasury bonds are more liquid and popular among investors (particularly during flights to liquidity), comparing their prices with those of Refcorp bonds may provide a way of testing whether there are flight-to-liquidity premia in Treasury bond prices." The study finds average liquidity premia in the range of 10bp to 16bp, depending on the term of the bond.

Other studies on US Treasury data have derived an estimate of liquidity premia by comparing yields on recent and older issues of government bonds. The newly auctioned government security is referred to as an on-the-run or new bond, while the one auctioned earlier is referred to as an off-the-run or old bond. With rare exceptions, an on-the-run bond trades at a yield lower than the yield of a similar off-the-run bond, which the paper argues may reflect differences in liquidity. In a recent study the observed spread between these U.S. yields over a period between January 1999 and February 2000 varied between 2bp and 10bp[6].

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

In addition, we note that if an allowance for own credit standing (see paragraph 4.5) is added to the basic risk-free rate, it may be justifiable to also incorporate a higher liquidity premium. This is because the reference

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[5] Longstaff (2001), The Flight-to-Liquidity Premium in U.S.Treasury Bond Prices,., http://repositories.cdlib.org/anderson/fin/5-01/

[6] Y2K Options and Liquidity Premium in Treasury Bond Markets, Sundaresan and Wang (May 2006), www.ny.frb.org/research/ economists/wang/y2k-options-0923.pdf

for the liquidity premium should then be more similar to a corporate bond liquidity premium.

4.4 Linked approaches

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

If, for example, the cash flows of a participating insurance contract are being measured, the expected investment return on the specified set of assets, together with their expected reinvestment rates should be reflected. In this case, it would be expected that expected policyholder behaviour would also be consistent.

This method of discounting would also be consistent with the obligations of a third party purchaser as well, as in this case the designated assets would also be transferred with the obligations.

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

In the related, but not identical situation of a contract in which the cash flows are indirectly linked through expected management behaviour, that is, through policyholder sales illustrations and management strategies, it may also be appropriate to link the expected investment performance, but not necessarily in a direct manner.

4.5 Credit characteristics of the liability

The purpose of this section is not to discuss whether to directly reflect the credit characteristic of the liability (sometimes referred to as *non-performance risk* or *own credit standing*), but rather to discuss possible approaches to measure this risk if it is required to be applied.

The first issue to resolve is how to reflect these credit characteristics. If the contract is a financial instrument, it would be logical to apply it through the discount rates. As significant insurance elements are included, a more relevant approach may to reflect these characteristics as a function of the

expected cash flows. However, if applied to the cash flows, then it may also be appropriate to reflect the uncertainty associated with these characteristics in the risk margin.

This is equivalent to considering that the liability cash flows to be valued are not certain to be paid. In practice of course, the shareholders of an insurance company do not have unlimited liability. They have no obligation to put more capital into the business and have the option of "walking away" from its obligations, either voluntarily or if forced to in the case of an inability to replace the exhausted capital. This would result in the amount of policyholder net cash outflows being reduced. From a shareholder perspective therefore, the liability cash flows are not certain to be paid in full, in theory at least, and there is a value to the "default option" of walking away from the liabilities in very adverse conditions. The more capital the company has, the less valuable this option is, and hence the market-consistent value of the liabilities of a strongly capitalized company or one who has either explicitly purchased or implicitly incorporates (through a state-sponsored guarantee fund for example) could in theory be larger than that of the liabilities of a more weakly capitalized company.

From a pricing perspective this would mean that (in theory) the price of the same liabilities 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 company a reduction in price may be necessary to compete for new or to keep existing business.

The following extract is from the IASB Insurance working group discussion in January 2006.

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

In practice, for many regulated insurers, the impact of their own credit standing may be very limited, given supervisory procedures that aim to minimise the possibility of any losses to policyholders. However, in some extreme cases, the impact may be material. For example, the guarantee may be applied if a pandemic of bird flu or a sudden crash in financial markets, or if an insurer is too important of a financial institution to let fail. A sudden decline in solvency may also lead to a situation where capital

markets are no longer willing to supply further capital to the company in support of its franchise value.

Rating agencies provide Claims Paying Ability ("CPA") ratings specifically aimed at reflecting this small possibility, and would also comment on this in their normal ratings. According to Standard and Poor's, "Insurers rated A+ offer good financial security, but capacity to meet policyholder obligations is somewhat susceptible to adverse economic and underwriting conditions".

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

- The methodology used by the ratings agencies to derive claims paying ability ratings is not always transparent. It may be based on nothing more than the perceived risk of the month or judgment that is not consistent with that of the market. Although the rating may be based on a quantitative model of the insurer's current capital strength, with little or no allowance for the possibility of future capital being raised. On a "going concern" basis it might be appropriate to assume that shareholders would seek to raise extra capital in case of financial distress, which would reduce the risk of default on policyholder liabilities. However, it could be argued that it would not be appropriate to reflect this in the measurement of the liability, but rather more closely related to a measure of capital.

- These ratings may present a conservative estimate of the own credit standing for the average insurance liability if they focus only on losses to the point at which the first claim cannot be paid.

- There is no deep market in policyholder liabilities (as there is for corporate bonds) enabling us to observe a credit spread for the liabilities of insurers of different ratings. However, although this implies that there may not be an observable metric to which calibration can be performed, qualitatively it may not be that much different than deriving estimates of credit risk on a modeled basis. Less controversially, such a credit haircut may be needed to apply to a ceded reinsurance asset.

- The credit spreads on corporate bonds bearing similar ratings may not be an appropriate measure because there may be no direct correspondence between probabilities of default on corporate bonds of a given rating and on policyholder liabilities of an insurer with the "same" claims paying ability rating.

- The most problematic problem that has not yet been fully explored is the regular assessment of this risk, the extent of which would be expected to vary with market risk preference, which may produce far greater volatility than what would normally be expected to be infrequent reassessment of the value of the contract's or portfolio's credit characteristics.

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

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

5. Current Estimates

The objective of this section is to discuss factors that may be appropriate in the development of current estimates as part of insurance liability measurement[7]. Current estimates have sometimes been referred to as "best estimates[8]," although the latter term has sometimes also been used to represent the estimate of the most likely possible (modal) outcome rather than the estimate of the probability-weighted expected (mean) value that will be discussed here and that most faithfully represents the current assessment of the relevant cash flows. In this paper, “current estimate” does not include the margin for risk included in insurance liabilities as discussed in Section 6, in contrast with some uses of the term "best estimate" such as in IAS 37 which does includes a risk margin.

Such estimates reflect unbiased expectations of the obligation at the report date and are determined on a prospective basis. A current estimate represents the expected present value of the relevant cash flows. In the case where the present value is based on a range of discount rates, it is appropriate to estimate the probability-weighted expected present value of these cash flows.

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

As noted below, in developing current estimates there is a decision making hierarchy to be followed. This starts with financial reporting standards (such as IFRS or regulatory) and continues with implications (such as constraints in measuring liabilities) and entity-specific accounting policy implications before reflecting market data and non-market data.

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[7] References to insurance liabilities also include related items such as ceded reinsurance assets. Similar considerations can also be applied to certain financial instruments that do not include significant transfer of insurance risk. However, these considerations do not always apply to these current measurement approaches (e.g., as indicated in IAS 39), either due to current financial reporting standards or to historical practice.

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

5.1 Key observations regarding and characteristics of current estimates

The following discusses recognition and (primarily) measurement issues associated with current estimates. Many of the observations are also applicable to the measurement of any financial item, including risk margins. The observations are not meant to describe current best practice in the measurement of the current estimate component of the estimation of liabilities of insurance contracts, although in some cases observations regarding certain current practices are indicated. Rather, they attempt to describe expected future practice; as such, it should not be taken to represent current best practice or standards.

5.1.1 All relevant cash flows to be included

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

Expected future catastrophic/calamity claims (e.g., exposure to concentration risk) are also reflected, although not in the same manner as was done in some jurisdictions referred to as a "catastrophe reserve" that represented an accumulation of a portion of previously paid premiums. In determining the present value of these cash flows, the probability-weighted expected timing of these cash flows would be reflected.

Note, however, that for the purposes of some accounting methodologies, a specified subset of these cash flows would be treated separately, as indicated in 5.1.2. In that case, clear description of those cash flows that either are or are not included should be disclosed. For example, some measurements will be conducted before or after income tax, or before or after ceded reinsurance, although in both cases often both bases are needed. See Section 7. 5 for treatment of product adaptability elements, such as terminal bonuses, whose total amounts may not be guaranteed.

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

A current estimate of a set of cash flows may be affected by requirements provided by a specified set of accounting principles, standards or

guidance. These standards or rules can include guidance with respect to, for example, the types of cash flows to consider in measurement or unit of measurement to apply. Certain financial reporting standards require market based inputs when relevant and reliable for use in the calculation of a current estimate (see Section 5.1.3), while another set of accounting standards may require certain inputs to be non-market based.

In addition, before a current estimate is determined, it is important to carefully define or confirm the object or scope of the estimation, i.e., what is being measured. In financial reporting, the initial step is to determine whether a set of possible cash flows must, or might under certain circumstances be recognized. To the extent that it is recognized, a comprehensive set of cash flows can be incorporated. For example, the calculation of current estimates often excludes associated income taxes, as they are recognized in separate calculations. Since all contractual rights and obligations are reflected, if the obligation is based on a specified set of assets, those assets should affect the current estimate of future cash flows.

5.1.2.1 Influence of financial reporting standards and guidance

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

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

- The measurement objective under which the estimate is made might be based on the expected settlement of the obligation, its transfer value or its "fair value," although in practice there may be little measurement difference.
- The expected values may not include all related expected cash flows. This may in part be due to what a financial reporting standard would recognize as an asset (e.g., due to lack of control by the entity) or a liability (e.g., due to lack of a present obligation).
- Alternative approaches to discounting currently exist. In some accounting systems, the financial reporting standard requires the use of risk free rates, while others use the expected investment earnings rate of a designated set of assets. Some do not permit discounting.

- The measurement of a current estimate might not recognize income tax directly derived from the cash flows resulting from the insurance contracts.
- 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 relationship rather than the contract, such as certain future renewal premiums that are not required to be paid under the contracts.
- Certain aspects of the measurement of a liability might be fixed at the time of the issue of the contract, being so-called "locked-in" unless an impairment exists.
- Different unit of accounts might be used.
- The estimate of expected cash flows of a contract developed by application of a required liability adequacy test might be substituted for the current estimate.
- The imposition of a cash value floor or prohibition of negative liabilities.
- A requirement that the insurer should not recognize profit at the time of issue.
- Changes in expected cash flows resulting from certain events occurring or 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.

5.1.3 Market and non-market inputs

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

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

5.1.3.1 Where pertinent and reliable information is available from a relevant market, measurement inputs[9] reflect observed prices or related information

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

Some financial reporting systems establish hierarchies regarding the priority order in which inputs are required to be based. In certain cases, relevant and reliable market-based inputs to current estimates are used, although care may be needed to isolate the current estimates from the risk margin. This means that information about cash flows is distinguished from transaction prices that allow for the risk characteristics of those cash flows. For insurance contracts, these inputs currently relate primarily to financial assumptions and should be generally accepted for this purpose.

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

A valuation technique or model is used to measure inputs based on non-market based price inputs reflecting portfolio-specific information regarding the underlying risk characteristics of the portfolio. However, if reliable portfolio-specific information for such a technique or model is not available or sufficient, such as would be the case in a new line of business, similar relevant entity or industry experience is used. This approach is used in pricing a portfolio, augmented where necessary by professional judgment. For instance, although industry or population mortality experience can be used as a basis for a non-market based mortality rate assumption, the observed experience of the portfolio usually provides more relevant information. However, while portfolio mortality experience is more relevant to the development of mortality rate assumptions, it may not be sufficiently credible (i.e., based on a sufficiently large body of data) to stand on its own.

Certain information is simply not available on a publicly observable basis, thus requiring model-based measures. For example, mortality or claim development experience that relates to the risk characteristics of the portfolio being measured is not normally available from a market, e.g., information regarding mortality is non-market based. In some cases,

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

observable prices 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, prices currently available may not relate particularly well to the characteristics of the risks being measured. This may arise from such factors as one-off events or the inability to make an unbiased adjustment to reflect the individual mix and volume of the business or claims involved or to include other factors such as new business. In such cases, the appropriateness of the information available needs to be considered prior to its use.

The following criteria, some of which are referred to in this section as characteristics, may be useful in determining non-market based inputs to the development of a current estimate, include:

- reflect the characteristics of the underlying portfolio for which the current estimate is made,
- be comprehensive,
- reflect all reasonably possible, relevant and foreseeable cash flows related to the market input; i.e., in cases of assumptions in which optionality or guarantees are involved, representative or stochastically generated relevant scenarios are considered,
- reflect policyholder, producer and insurer behavior, where appropriate,
- apply within the scope of the measurement of what is being measured,
- be internally consistent with other measurement inputs and the measurement approach used,
- be internally consistent between current estimate and risk margin calculations,
- be representative of expected experience,
- 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.

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

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

For most insurance contracts, the use of a contract as the source of observable information would not be reliable. For example, if a single contract were used as the unit of account, both a large expense assumption would result and process risk (i.e., statistical deviation and volatility of experience due to the size of the portfolio, discussed in Section

7.1) would be fully recognized. In addition, an industry-wide or even entity-wide basis would not be used, as the resulting assumptions would usually not be relevant to the exposures and risks and obligations of the portfolio of contracts. Thus, the portfolio is the appropriate unit of account to use, as long as it is relevant and reliable for the purpose.

The historical experience of the specific portfolio or even similar risks of the entity may not be of adequate size to produce credible relevant experience ("credibility" as used in actuarial literature usually refers to the extent to which the information can be relied upon, while "reliability" in accounting literature is usually meant to refer to the extent to which a financial item is measurable). When credible, portfolio-specific experience data is generally considered more relevant than that from the industry (or the general population). This is because it is based on the business being valued: its risk characteristics, the coverage and insured mix reflecting the effect of any underwriting selection performed, and other characteristics such as claim management. However, when fully credible portfolio-specific data is not available, industry (or general population) experience data can also be useful, although adjustments to it are often appropriate to reflect differences in risk characteristics, possibly as a supplement or validation of the assumptions made or in the case of a new line of business.

5.1.4.1 What is a portfolio and why is it important

The extent of aggregation of contracts into a relevant portfolio is determined on the basis of the facts and circumstances involved. The portfolio level is usually considered to be the relevant unit of account applied in measuring current values.

This is relevant in part to reflect the effect of pooling on the risk margin and to avoid the otherwise onerous effect of not reflecting any economies of scale on expense levels included in the measurement of the liability. Consistent with these reasons, IFRS 4.18 indicates that a portfolio is an aggregation of contracts that are subject to broadly similar risks and managed together. Although for a mono-line insurer it might include the entire business of an entity, in most entities relevant portfolios would constitute subsets of it. Even in the mono-line case, different portfolios may exist reflecting the use of such factors as different marketing channels or segments. It is not just the type of insurance exposures involved that is important in selecting relevant portfolios, e.g., private passenger automobile and commercial auto may constitute separate portfolios although they are subject to the same types of claim risk. In this case, the method of management of the exposures can also be among the important factors to consider. The relevant concept is that it is the

characteristics and management of the insurance contracts that contribute to the determination of the portfolio.

The use of a portfolio-based measure is usually more appropriate than an entire entity basis, as the entity can comprise a wide range of insurance and other contracts that may not be relevant to the portfolio. The liability measurement should generally be related to the portfolio's characteristics rather than those of the entire entity. These characteristics include risk and product mix, contract terms, insurance risk characteristics reflected in their underwriting criteria, as well as the entity's processing and data systems used to manage the portfolio and its claim adjusting policy. In other words, the inputs to the measurement of a liability should reflect the relevant risk characteristics of the portfolio and the business model used to obtain and manage the business. Of course, excessive small portfolio may be harmful. For example, the experience of too small portfolio may include huge fluctuations and it may hide, in practice, the real level and trend of the experience.

Nevertheless, certain practical issues may cause a portfolio's expected value to differ depending on the entity that holds it. In particular, this may include operating expense assumptions. Due to the uniqueness of most insurance portfolios and differences between management methods, in practice it is thought by some that portfolio experience and expectations regarding servicing costs will usually be the same in whatever entity it is in. Because most assumption interaction affects the risk margin rather than the current value, this is not discussed further in this section.

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

5.1.5 Current estimates in contrast with current conditions

The assumptions used to derive a current estimate reflect the current expectation based on all currently available information about the relevant cash flows associated with the financial item being measured. 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 blindly applying recent historical or current experience. Although historical or current experience is often the best source from which current expectations of future experience can be derived for a particular portfolio,

current estimates of cash flows should not automatically consist of a reproduction of recent experience.

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

While in some cases, recent historical and expected future experience will be identical, in others they will differ, possibly by a material amount. For example, although a change in national macro-economic policy on the day of the valuation might be considered in establishing current conditions, such a change would not have affected historical experience. Also, a recent medical breakthrough and a threat of a global epidemic are also examples of situations in which current conditions have not yet influenced recent experience. The decision as to the extent that current conditions should be directly reflected or only be used as a consideration to the estimation process can vary by type of assumption (e.g., expense reduction effort or impending law change with possibly voluntary termination effects).

5.1.6 Consistency of assumptions

If two or more current explicitly determined assumptions are related, i.e., they are either positively or negatively correlated, the application of these assumptions should be reflected in current estimates in a consistent manner. For example, mortality experience can be affected by contract continuance rates, as increased discontinuance can lead to anti-selection and thereby to higher mortality than otherwise expected, as the best mortality risks may be able to exchange their contracts for those with lower premiums. As a result, the mortality assumption regarding future mortality experience for a particular portfolio should be consistent with the contract discontinuance rate assumption. If multiple scenarios are used by the valuation technique to measure the expected value of an obligation, the mortality assumption should be consistent with the contract discontinuance rate assumption within each scenario applied, although approximations might be used as long as the approximations are suitably validated and in compliance with the applicable financial reporting standards.

If financial reporting standards or guidance affect the recognition and measurement of the current estimate, the assumptions within a given scenario should be consistent. For example, if interest-rates are assumed

to be market-consistent, then it would be appropriate to reflect policyholder behavior that is consistent with these market-consistent rates.

Certain financial reporting constraints on the development of assumptions used can create inherent difficulties in developing estimates of the interrelationships between assumptions. For example, in a given financial reporting system, a liability of a contract may not be permitted to be recorded at less than its cash surrender value, may not recognize non-guaranteed elements, or may be based on a rational expectations model (i.e., the worst case scenario within a probable range of outcomes), even though market observations indicate that those who pay premiums do not act consistently with those assumptions. The result of such constraints would not be a realistic current estimate.

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

The issue of consistency of assumptions over time is an important one, relating to the extent of responsiveness to reported changes in experience. In general, it is preferable to revisit assumptions on a regular basis, and to avoid waiting for a large catch-up change. Nevertheless, actuarial credibility can also be important to consider to avoid offsetting changes every period. See 5.1.11 for a more indepth discussion.

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

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

Once the valuation technique (market-based or non-market-based) is selected, the input parameters (assumptions) are then derived. In certain cases, the use of inputs from multiple valuation techniques can enhance

the reasonableness of the current estimates. Depending on the portfolio whose current value is being measured, valuation assumptions for the technique selected can include the incidence, severity, claim development and timing of claim settlement, mortality, morbidity, policyholder behavior, expenses, and investment returns or discount rates, or their interaction.

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

The process and method used may not be unique and can in some cases be somewhat portfolio-specific, depending on the type of available experience data, and can involve significant judgment. In some cases, many assumptions can be involved, to the point that it may be difficult to isolate a specific assumption. For example, certain assumptions that might provide separate inputs to the estimation of certain cash flows may be difficult to isolate, such as in a separate hypothetical analysis of the frequency and severity of claims if claim counts are not available. In such a case, the use of their combined effect would be more reliable, or it may be more credible to directly estimate the total losses or benefits rather than to derive separate distribution functions of the number and size of the claims or benefits and then to combine them.

5.1.8 Asymmetry of expected losses or benefits

Expected cash flows can be influenced by the following factors:

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

In many cases a non-symmetric probability distribution applies, e.g., as a result of a fat or catastrophic tail or a one-sided limit on possible values such as non-negative mortality rates or other contract terminations. Other non-symmetric examples include guarantees (minimum cash value or interest rate credited or maximum cost of insurance charged); limits to values (e.g., reinsurance retention limits or non-negative contract

termination assumptions); or asymmetric severity (e.g., relatively few partial losses). In these cases average values of observations not reflecting the asymmetric effect of such assumptions may not produce a reasonable current estimate. As a result, when it makes a significant difference in the current estimate, the effects of asymmetry should be reflected.

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

5.1.9 Approximations

Approximations can be made to individual assumptions or to aggregate estimates that are developed in a relatively simplified manner that produces reasonable estimates. Approximations are often used for minor assumptions or if the current estimate is not sensitive to variations in one or more assumptions, the sensitivity of which can vary by contract. They are usually made for practical reasons, but nevertheless they should be performed in a technically sound manner. For example, in many cases a mid-year assumption for cash flows represents a sufficiently accurate estimate for the purpose of estimating the timing of future annual cash flows, and the average age in a quinquennial age grouping may be appropriate in many situations. Nevertheless, such simplifications may not always be appropriate, depending on the facts and circumstances involved.

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

If a small entity or unique portfolio is involved, it can be appropriate to use a less refined model or larger groupings. In particular, an extensive data

base of portfolio-specific experience is not likely to be available. Nevertheless, even in this case it is necessary to be convinced that the model and assumptions used are sufficiently reliable and could be used to produce an unbiased current estimate.

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

5.1.10 Quality of data

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

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

Assumed (inward) reinsurance can present a particular challenge when the data made available by the cedants is limited, of poor quality or late (sometimes by one to several quarters). The problems can relate either to experience or to the amount of business which is 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 some estimate is better than none at all (at least to the extent of a lower bound of an estimate), although accounting literature indicates that where no reliable basis exists, no value should be included in the balance sheet, and instead disclosure of the risks and uncertainty involved should be included in 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.

Situations of interest to actuaries where an expected value cannot be derived are relatively rare. More useful financial information may consist of a minimum liability value if it can be determined in a reliable manner, with appropriate disclosure of the source and extent of the uncertainty involved.

5.1.11 Updating assumptions

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

5.1.11.1 Non-market based assumptions

The derivation of a estimate of non-market assumptions on the basis of current expectations should be reviewed regularly and systematically at each measurement date. While a review is needed at each measurement date and at least annually, an update of each assumption at each measurement date may not be needed, as significant credible new information to change an estimate may not be available.

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

The measurement of the amount of insurance liabilities and reinsurance assets is regularly updated when current expectations differ from those incorporated in the prior estimates. Generally a revision is made at a measurement date when the effect on current estimates from differences between current and prior expectations become significant. In assessing the credibility and relevance of the differences, the same general guidance applies as provided in the previous paragraphs. In some cases, an

update to an accounting estimate would have to be significant before it is required. Usually financial reporting requires that it is the effect on the liabilities for which materiality is assessed, rather than on the individual assumption. Except in the case where constrained, an update would always be permitted if the accounting consequence is not material, although such an update would not be required.

These differences can arise for several reasons, including:

- A previous assumption based on incorrect or limited data. Enhanced data or an expanded experience or data source can enhance current estimates.
- The developed experience may not be actuarially credible due to the amount of the available experience data or that the experience resulted from conditions that are not expected to continue. Note that credibility is a continuum, that is, experience data can provide partial but complete assurance regarding that experience that is being measured.
- An incorrect model of future cash flows. For example, it may have been assumed that future cash flows were distributed according to probability distribution A, when it is subsequently determined, based on additional information or changed conditions, that they are more consistent with probability distribution B. Or more knowledge is gained regarding cash flow drivers. In addition, a factor contributing to an assumption or the interaction between two assumptions may have been overlooked that will influence the future cash flows.
- Estimates of the assumption of an underlying probability distribution may differ from actual experience. For example, a distribution with a mean of 100 and a standard deviation of 10 may have been estimated, when it is subsequently determined, based on additional information or changed conditions, that the distribution actually has a mean of 120 and a standard deviation of 15.

Another case is the common assumption that the current law remains in effect in the future. In this case, estimation challenges may arise if there are changes to statute or case law, or if any such changes are expected. In any case, the basis of the assumptions used should be reviewed periodically.

It is a best practice to document the basis for and the effect of experience adjustments and changes, and in most cases the basis for not updating assumptions.

Financial reporting standards often distinguish between errors, changes in accounting estimates and changes in accounting policy. IASP No. 8, *Changes in Accounting Policies under IFRS [2005]* describes such differentiation in more detail. Any changes need to be so categorized, as they are treated differently. However, such a determination usually depends on the facts and circumstances involved. For example, a move from decennial age groupings to quinquennial age groupings or a change in development factors are usually considered to be a change in estimates, while the introduction of a mortality trend or a change from a market-based to a non-market based discount assumption are examples of a change in basis or accounting policy.

5.1.11.2 Market based assumptions

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

5.2 An example of determination of the current estimate for mortality incorporating information about level and trend

One of the co-chairpersons of the RMWG, Henk van Broekhoven, has published a paper (van Broekhoven (2002)) concerning how to use current and past observations about mortality to construct current estimates for levels and trends of mortality. While the mortality risk is just one of the many risks assumed by certain insurers, the thought process developed in the paper can be applied to many other important insurance risks as well.

The method described in the paper is meant to be a practical one. Although more sophisticated models exist, for practical reasons Henk chose a model that was both easy to use and explain. The future trend he used is based on population mortality development observed during a recent period. Older historical experience also can provide context as to how the trend can change over time. These observed changes are used to measure the trend uncertainty. Entity or portfolio observations regarding trends will normally demonstrate relatively high volatility due to the fact that the number of observations is smaller than that of the overall general population and to the effect of changes made in underwriting criteria over time. These volatile observations give rise to expectations concerning the level of uncertainty. This uncertainty is derived using a statistical method by measuring this volatility.

In the paper, calamity (or "extreme event") risk is based on the only historical observation for which data is available – the Spanish Flu in 1918 - 1919. This pandemic caused a doubling of mortality for the younger ages

over a one-year period after which mortality levels returned to trend. The calamity capital for mortality is based on this scenario.

6. Risk Margin Measurement Methods

This section describes the objectives of risk margins over current estimates (MOCE) and how several approaches might be applied in theory and in practice. The section also includes a quantitative and qualitative comparison of the approaches.

More specifically this section covers the following:

Section	Subject
6.1-6.3	Objectives, desirable characteristics of, and approaches for determining risk margins over current estimates (*MOCE*),
6.4 & Appendix A	Statistical concepts underlying risk measurement,
6.5	Examples,
6.6	Quantitative Comparison of Methods
6.7	How pooling, diversification and other aspects of context affects risk margins
6.8	Risks to be considered
6.9	Time horizon and risk distributions
6.10	Practical issues
6.11	Qualitative comparison of methods

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

6.1 The objectives of risk margins

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

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

Two aspects of such a transfer can be distinguished:

a. Contract-owner view. Due to the inability of an individual/enterprise to deal effectively with its own risk as to the frequency, timing and/or the severity of pertinent contingent events, pooling of reasonably homogeneous risks is needed. In this way, the individual contract-owner can spread his/her risk by transferring it to a pool of similar risks.

b. Insurer view. The insurer has the ability to manage these risks through a number of risk management techniques, including the pooling of similar risks (usually similar in terms of the characteristics of the risk subjects, but this pooling could occur over time as well), diversifying across multiple pools risks, reinsuring, or securitization of the risks (this has been done only in a limited set of circumstances to date).

While the transfer of risks to the insurer allows the insurer to pool the risks and to mange these, insurance obligations remain, by their nature, uncertain.

Until the transferred obligations are settled, the insurer records a liability for its remaining obligations. It is generally agreed that the liability which is recorded should include an estimate of the expected value of future cash flows plus a risk margin to reflect the remaining uncertainty. There is less agreement on how to determine the level of risk margin in the liability. Two perspectives on this issue might be called, "provision for cost of risk bearing" and "policyholder protection".

Risk Margin as a provision for the cost of bearing risks – exit value approach
For general purpose financial reporting the IASB has recently proposed that the risk margin should be developed so that the current estimate plus risk margin represents a 'current exit value' i.e., '…the amount an insurer would expect to pay at the reporting date to transfer its remaining contractual rights and obligations immediately to another entity'[10].

When there is a deep liquid market for insurance liabilities, then this exit value would be observable in that market. The exit value determined from that market would include a provision for the 'cost of risk bearing.' Alternatively it can be viewed as the reward for risk bearing on behalf of the insurer. Generally, the financial component of insurance cash flows (current estimates) can be hedged (replicated) by financial instruments (assets, derivatives, etc.) available in the market. Hence, for this part it is generally possible to refer to market prices for similar cash flows. For this part the market price already provides an investor with an expected return sufficient for compensation for the risks in that investment relative to alternative investments. In the terminology used in this paper, the market price includes both a discounted current estimate of expected cash flows and a risk margin in excess of that amount.

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

However, for the non-hedgeable risks such as insurance risks (e.g., mortality, morbidity, and unpaid claim obligations), there is no such market. The IASB suggests that this value should be determined with a model having three building blocks: the current estimate of the future contractual cash flows, a discount reflecting the time value of money and a risk margin[11].

In this model, it is assumed that a rational transferee would require something above the current estimate (even if transferor and transferee were to agree perfectly on the level of the current estimate). Otherwise, the transferee would expect to receive nothing for taking on the risk if everything does not work out as expected. This amount, the margin over current estimate, can therefore be regarded as an additional amount "for uncertainty". This risk margin would reflect the 'cost of risk bearing,' a compensation for the transferee for the risk of taking on an obligation to pay uncertain cash flows.

Hence, a reasonably rational methodology for calculating this margin over the current estimate is to put oneself in the position of the transferee. What thought processes might the transferee go through in order to work out what extra amount it might require over the current estimate? Presumably, the answer is as much as possible, but in a market in equilibrium, the margin would be based on a reasonable return reflecting the risk of uncertainty. At market equilibrium, the margin would also reflect how the risks and returns of alternative investments and the manner in which an investor might construct a diversified portfolio of investments. If observable evidence existed that transferees would take on the net obligations at a very low return in view of the uncertainty involved, then the risk margin should reflect this lower return.

Once this is agreed to, the margin over current estimate could potentially be estimated by various different methods. The application of any acceptable method should endeavor to incorporate what a rational market participant may require.

Risk Margin for 'policyholder protection' – as an element of prudence. Financial reporting for insurance regulation has 'policyholder protection', i.e., assurance that obligations to policyholders are met, as a primary objective. Towards that end, insurance regulators generally have had the authority to specify the valuation of assets and liabilities and the amount of addition funds, i.e., capital, the insurer needed to have to remain in

[11] It should be noted that the IASB Discussion Paper refers also to a margin for providing services, if any. In the context of this paper, only the risk margin is discussed.

business. To a degree that varies by jurisdiction and has changed over time, regulatory financial reporting regimes value each asset and each liability on a 'conservative' basis. In this framework, each asset and liability has a recorded value that covers adverse deviation that can be expected under normal circumstances. In this regards, capital is an additional provision to the cover unexpectedly unfavorable outcomes.

One of the areas of complexity in setting risk margins from the 'policyholder protection' framework, is in establishing the boundary between the roles of risk margins and capital. Regulators and policyholders require that insurers hold capital at a level such that total insurer assets, which include current estimates, risk margins and capital, are adequate to cover obligations with a sufficiently high probability. If risk margins were higher (or lower), then normally the required capital should be lower (or higher). This makes it appear that risk margins and capital are indistinguishable. However, while the quantitative separation is somewhat arbitrary the qualitative separation is reasonably clear. Risk margins cover adverse deviation that can be expected under normal circumstances, while capital covers unusual adverse deviation. Put differently, both risk margins and capital are available to finance the cost of adverse events, risk margins first and capital second.

Link between the two risk margin perspectives
The prudence element in the regulatory liabilities refers to the ability to absorb reasonable uncertainty in experience. If experience is more favorable than that assumed in the current estimate, with risk margins, the release of the excess risk margin creates a "profit" that serves as a reward for the investor that has taken the risk; if experience is worse than expected, the risk margin covers some part of the expected losses.
In essence that is the same perspective an investor would have in taking over the liabilities as this uncertainty defines the reward for covering the expected costs.

Moreover, the IAIS recognizes that both the policyholder protection and cost of risk bearing objectives must be satisfied. To do that, the IAIS, in the IAIS *Second Liabilities Paper, paragraph 11* [12] *states* "The IAIS stresses that any transfer would need to be made to an entity capable of accepting the transfer which, in the case of a regulated industry like insurance, implies that the transferee would also need to be regulated and capable of settling the obligation to the claimant/beneficiary." Accordingly,

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

the IAIS believes that any transfer notion would be strongly influenced by the settlement obligations that the transferee would undertake."

Hence, the risk margin under both perspectives will need to be determined in a manner consistent with what investors require, to the extent that can be determined. The use of this approach is consistent with the economic capital described in the Blue Book, as well in more detail in a presentation[13] to the IASB's Insurance Working Group in January 2006.

In certain accounting models, a total margin is applied at issue rather than a separately calculated risk margin. In this case, the risk margin can be used as a measure by which to release this total margin. The effect of this constraint is discussed in Section 8.2.

6.2 Desirable risk margin characteristics

In the *Second Liabilities Paper*[14], the IAIS takes the position that, "(w)ithout prescribing any one method(ology) at this stage, the IAIS believes that any methodology for calculating the margin over current estimate should share certain characteristics."

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

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

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[13] *Cost of capital approach for setting risk margins in market value of liabilities* – a presentation to the IASB Insurance Working Group by Francis Ruygt on 12 January 2006; and *Cost of capital approach for setting risk margins for insurance contracts liabilities – Background paper by presentation on examples to calculate MVL's applying a cost of capital approach for setting risk margins*.

[14] Issues arising as a result of the IASB's Insurance Contracts Project – Phase II – Second Set of IAIS Observations, May 2006, page 11

This wording was suggested by observers from the RMWG reflecting its research to the date of preparing the Exposure Draft of this paper. While the characteristics are expressed in a form that is risk oriented, the RMWG believes that the characteristics are also expressed reflecting the way the insurer to insurer (exit value) market works in practice where such markets exist.

The IASB identified the same properties as being desirable for risk margins in general purpose financial reporting.[15]

In addition, the RMWG believes it is desirable for the risk margin methodology to have the following characteristics:

1. Have a consistent basis at issue and subsequent to issue, i.e., for the entire lifetime of the contract;
2. Use underlying assumptions consistent with those used in the determination of the corresponding current estimates;
3. Have a consistent risk margin methodology with other financial contracts; and
4. Where possible, be determined in a manner consistent with accepted economic and actuarial pricing methodologies.

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

- Provides up-to-date relevant information about earnings from current business and the difference between actual and expected results from obligations not yet settled.
- Is consistent between reporting periods for each company,
- Is consistent between companies at each reporting date.
- Shows earnings only when they are sufficiently reliable to provide users of financial statements with guidance useful for making decisions.

[15] IASB, Preliminary Views on Insurance Contracts, Part 2: Appendices, Section F4, page 34-35, 2007

6.3 Possible approaches to risk margins

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

1. "Quantile Methods", including percentile or confidence levels and the related methods that are often considered with quantile methods, specifically conditional tail expectation (also called tail value at risk or TVaR) and multiples of the second and higher moments of the risk distribution.

2. Cost of capital methods

3. Discount related methods

4. Explicit Assumptions

5. Conservative assumptions in the current estimate producing implicit risk margins

The first four of these methods are described in section 6.5.

The IASB identified the following approaches that might be used to establish a value for risk margins for general purpose financial reporting:[16]

a) Confidence levels
b) Conditional tail expectation (CTE, also called Tail Value at Risk or TVaR)
c) Explicit margin within a range
d) Cost of capital
e) CAPM
f) Deflator adjusted cash flows
g) Multiple of standard deviation, variance, semi-variance, or higher moments.
h) Risk adjusted discount rate

IASB methods a, b, and g fall in the Quantile family. Methods c falls in the explicit assumption family. Method d is the cost of capital family. Method e, CAPM, relates to asset values, it has been used in capital allocation, which can affect certain risk margin calculations, it could theoretically be applied to liabilities, but there is not practical literature on its use in risk

[16] IASB Part II, section F9, page 36-37

margin calculations directly. Methods f and h fall into the discounted-related family.

IASB rejects the use implicit margins produced through either unspecified confidence levels by use of conservative assumptions.[17]

The IAIS identified the quantile and cost of capital methods as "two methods being referred to or used by the industry and some regulators," but has not identified any preferred methods.[18]

6.3.1 Risk Margin Approaches -- Historical Perspective

Largely in order of historical emergence of the method, we observe the following:

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

Adjustments in the discount methods have sometimes been used as explicit assumptions, e.g., specified interest rates for discounting that are less than market interest rates including the decision express general insurance unpaid claim obligations on an undiscounted basis. Other discount methods are based on economic principles, e.g., life insurance embedded value calculations that assess future distributable earnings using discount rates that include a risk premium that the market requires – generally based on a CAPM type approach.

Quantile methods for regulatory purposes are more recent. Australia, for example, requires that general insurance reserves to be set based at confidence levels, subject to being at least a minimum number of standard deviations above the mean value.

Cost of capital methods have been used for several years in life insurance embedded value calculations. It is used as part of the Swiss Solvency test, and it has been suggested by some as the best approach to modeling market values of liabilities.

Conservative implicit assumptions are sometimes used in determination of actual liability amounts. From a policyholder protection perspective, to the

[17] IASB Part II, section F9, page 36-37
[18] IAIS Second Liabilities Paper, 2006, page 12.

extent that conservative assumptions produce higher liability values, this is viewed favorably, but these are not part of the formal regulatory process.

From the perspective of general purpose financial reporting, risk margins include as a provision for adverse deviation that might be either implicit or explicit based on one of the methodologies. In some cases historic assumptions (as set at issue) are used, and that is perceived to bring an element of prudence (for example the use of historic mortality rates in term insurance that do not take account of ongoing mortality improvements)

6.4 Statistical Concepts

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

A risk distribution (or just distribution) gives the probabilities that different outcomes of an uncertain process will be observed.

The normal distribution is a distribution that gives the probabilities for well behaved phenomena. The normal distribution is 'symmetric' in that for every 'good news' scenario there is an identical and equally likely 'bad news' scenario. It has a specific form that requires two parameters, the mean (or average) which indicates its central point and the standard deviation which indicates how wide the distribution is.

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

One feature of most insurance risks is that policies have a high probability of having no claim or policy obligation in a reporting period; having a small probability of claim amounts/obligations and an even smaller probability of having a large claim. Statistically, distributions like this are described as having 'positive skewness' or being 'skew'. They have a parameter for 'skewness' (represented by γ, the Greek letter gamma) that is greater than zero. The normal distribution, because it is symmetric, has zero skewness.

Combining many policies often reduces the skewness, but does not eliminate it. For some types of coverage, e.g., coverage of natural catastrophes, combining policies may not reduce skewness as claims

happen on no policies or on many policies simultaneously. This makes the related risk distributions particularly skew.

In addition to the characteristics of the risk distribution discussed above, the other principal driver of the risk margin methods discussed here is the time it takes to settle claims/policy obligations. The risk distribution and the settlement times can be related as obligations that take longer to settle often have greater skewness and larger coefficients of variation.

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

Table 6.1 Assumptions used for risk margin examples

	Sample Lines of Business			
Variable	**Product A**	**Product B**	**Product C**	**Product** D
γ (gamma)	0.2	0.4	0.8	8
Coefficient of variation (CV)	3.0%	13.3%	26.1%	151.3%
Settlement pattern	Life – long	GI- medium	GI-longer	GI- medium
increase in ratio of capital to discounted current estimate (p.a.)	0%	10%	10%	10%
Notional Coverage Type	Simple Life products	Motor third party liability	'Risky' liability	Catastrophe coverage[19]
Risk distribution	NP	NP	NP	LN

Notes:
1. The three payment patterns are shown in Appendix A, Table A.1.
2. NP refers to normal power approximation. LN refers to log normal distribution. The risk distributions for Products A-C are compound poison models represented by the normal power approximation with the selected skewness and CV. For Products B and C those normal power approximations are very similar to lognormal distributions with the selected CV's. For product A, the lognormal equivalent would have a CV of 6.7% rather than the selected 3.0%. Product D uses a lognormal distribution. Appendix A section 5 compares the NP and LN distributions.

6.5 Approaches to quantifying risk margins

In this section we discuss each of the risk margin approaches listed in section 6.3.

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

6.5.1 Quantile Approaches

Confidence levels are the most widely recognized quantile method. Risk margin methods based on confidence levels express uncertainty in terms of the extra amount that must be added to the expected value so that the probability that the actual outcome will be below 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.

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

Table 6.2 Confidence Levels– Number of Standard Deviations

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

*Conditional Tail Expectation, also called Tail Value at Risk. Defined in Appendix A, Section 2.

The risk levels in Table 6.2 are described as multiples of the standard deviation because in that format, the results do not depend on the width of distribution. Note that the risk margin measured as the number of standard deviations above the mean decreases as the skewness increases, becoming negative in extreme cases (Product D).

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

Table 6.3 Confidence Levels- % Discounted Current Estimates

Coverage Type	γ	Confidence Level (number of standard deviations required to reach required level of confidence)				
		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%

Points to note from Tables 6.2 and 6.3 are the following:

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

- From Table 6.2 we saw that for 65% and 75% confidence levels, the risk margin measured as number of standard deviations decreases as the risk distribution becomes more skew (down the column). This is equivalent to observing that in order to have the risk margin at the same multiple of standard deviation for all policy types, the confidence level would be larger for distributions with more skewness.

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

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

- We did not illustrate the variance, semi-variance or higher moment methods as there is no practical literature on their use in determining risk margins for liabilities.

The risk margins illustrated in the Tables above assume that risk should be measured separately for each line of business based on the

experience of the reporting company alone. Section 6.7 discusses alternative contexts in which to measure the percentile levels.

6.5.2 Cost of Capital Method

Requirements
To apply the cost of capital method we need the required capital and the cost of capital at the reporting date. In addition we need the required capital and the cost of capital at each age of development of the runoff of the obligations. As a practical matter, since the required capital generally depends on the best estimate of the liability, we also need the cash flows that will allow us to project the estimated liability at each future reporting period until the policy/claim obligations are settled.

Cost of Capital
By cost of capital we mean 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. For example, ignoring taxes and other frictional costs, if the total required return is 12% and the return on capital is normally 7%, then the cost of capital would be 5%.

There is no accepted method for determining the cost of capital for purposes of determining risk margins. A value of 6% is used in the SST for a capital level described as a 99.5% confidence level and is described as approximating a BBB financial rating. A value of 4% has been used been used in industry presentations as applicable to companies with capital at a 99.95% level described as approximating an AA financial rating level. We use 6% in most of our illustrations, but are not proposing that 6% or 4% are appropriate values. We discuss this further in the Section 6.10 Practical Issues

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

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

Table 6.4 Capital Levels ---Number of Standard Deviations

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

Table 6.5 Capital Levels ---% of Discounted Current Estimate

Coverage Type	Skewness (gamma)	Confidence Level (number of standard deviations required to reach required level of confidence)				
		Confidence Level			CTE	
		99%	99.5%	99.95%	99%	99.5%
Product A	0.2	17%	18%	24%	9%	9%
Product B	0.4	35%	39%	52%	41%	45%
Product C	0.8	76%	87%	120%	91%	101%
Product D	8.0	598%	816%	1898%	1083%	1374%

The five capital levels shown in the tables above are those suggested for capital requirements in various settings. The 99.5% confidence level is referred to in the Swiss Solvency Test and the UK ICAS regime. This could be thought of a roughly a 1/200 year per company or 1 in 200 company failure rate. It is sometimes interpreted as being equivalent to a BBB bond which has a similar risk level, although the historical BBB confidence level varies. Also, the BBB default rate refers to defaults per year. In the insurance context, the confidence level also often refers to the entire runoff of the obligations (see section 6.9 for further discussion).

The 99.95% confidence level is often described as the AA risk level. As we discussed in confidence level risk margins, the Conditional Tail Expectation (CTE) levels are often suggested as alternatives to confidence levels, particularly when distributions are skew. Even for the range of skewness shown here, however, the capital levels indicated by CTE and confidence levels are reasonably consistent.

Release of Capital

The amount of capital required might be expected to decline as the size of the unpaid claims/policy obligations declines, but not necessarily in a

uniform way. For example, the number of claims/policies remaining unsettled decreases as the runoff progresses, and the coefficient of variation and skewness of the distribution can increase because there is less pooling effect.

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

A detailed analysis of required capital by age would be required in actual application. For simplicity in our examples, we assume that the required capital, as a percentage of the current estimate increases uniformly at 10% per year.[20]

Sample Calculation

Table 6.6 illustrates the cost of capital method as applied in the SST to the Illustration of Product B (like motor liability coverage).

Table 6.6 –Cost of Capital Calculation for Product B ("Motor")

1	2	3	4	5	6	7
	Liability	Req'd Capital %	Req'd Capital	Cost of Capital	Risk Margin	Risk Margin
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 required capital is based on a 99.5% confidence level; 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 coverages produces the results in Table 6.7 below.

[20] SST and other cost of capital illustrations for general insurance have assumed that capital is released at the same rate that claims are paid. We view that as an understandable, but unrealistic. Assuming a constant factor is also simplistic, but more realistic. This is an area that requires further research.

Table 6.7 – Cost of Capital Sensitivity Tests

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

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

Line 2 shows the effect of setting initial capital to a 99.95% standard but using a 4% cost of capital. The increase in capital requirement (from 99.5% to 99.95%) alone would raise the risk margin. The reduction in cost of capital would reduce the risk margin. The two effects combined to produce risk margins within 10% of each other, except for the more highly skewed Product D where the increase in capital requirement has a much larger effect than the reduction in cost of capital.

Line 3 shows the effect of setting initial capital to a 99% Condition Tail Expectation (CTE) level and using a 6% cost of capital. The results are relatively similar to the line 1 result for Products A and B, with lower skewness The CTE-based risk margins are higher for Products C and D, with higher skewness. The result for Products C and D follows from the higher capital requirements implied by the CTE approach. We believe the CTE values would be a better reflection of risk for the more skew products than the percentile levels.

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

The values shown above are based on the SST approach. Appendix A Section 3 shows alternative interpretations of the cost of capital method.

6.5.3 Discount-Related Risk Margins

Risk Adjusted Returns
A risk adjusted discount method uses the risk free interest rate minus a selected risk adjustment.

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

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

It has been shown 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.[21]

Deflators
Deflators, identified in the IASB Discussion Paper, are usually applied to asset values, and there is no practical literature on how to apply them to non-hedgeable risks in life insurance policy obligations or general insurance unpaid claim obligations.

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

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

Coverage Type	γ	Discount Assumption	
		No discount	Risk free less 2%
Product A	0.05	44.6%	19.0%
Product B	0.42	7.7%	3.7%
Product C	0.95	23.4%	10.7%
Product D	8.00	7.7%	3.7%

[21] Julian Leigh, *Fair value reporting, Implications for General Insurers*, Staple Inn Actuarial Society, 2004 http://www.sias.org.uk/view_paper?id=FairValueAccounting

Products B and D show the same risk margin, even though intuition suggests that the extreme event risk requires a larger risk margin. This occurs because the discounted-related risk margin reflects only payment timing and no other features of the risk distributions, and Products B and D assume the same payment patterns.

Also, because the life product (Product A) has the longest time to settle obligations, it has the largest discount rate in these methods even though intuition suggests it should have the lowest risk margin.

6.5.4 Explicit Assumptions

The working group found that there might be different interpretations of the terms 'explicit' and 'implicit'. The IASB did not full differentiate 'explicit' risk margins from 'implicit' risk margins. For purposes of comparing risk margins based on 'explicit assumptions', we treat margins as explicit if the amount of the margin over the current estimate is calculated and disclosed.

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

1. Use a specified mortality, morbidity or other table. Use best estimate of mortality tables adjusted by x% to consider risk (x upward for life insurance and downward for annuities).

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

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

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

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

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

6.6 Quantitative Comparison of Methods

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

Table 6.9 – Comparison of risk margins from different methodologies

Risk margin approach	**Product A**	**Product B**	**Product C**	**Product D**
1. 65% confidence	1.1%	4.4%	7.1%	-16.0%
2. 75% confidence	2.0%	8.5%	15.7%	15.1%
3. 90% confidence	3.9%	17.6%	35.7%	123.2%
4. 40% CTE	1.9%	8.4%	16.2%	51.7%
5. CoC - 99.5%VaR*	4.1%	4.5%	36.8%	94.7%
6. 0% discount	44.6%	7.7%	23.4%	7.7%
7. 2.5% discount (Risk free – 2%)	19.0%	3.7%	10.7%	3.7%
*Initial Required Capital %	8.3%	39.1%	86.8%	816.3%
Notional Coverage	Simple Life products	Motor 3rd party liability	'Risky' liability	Catastrophe coverage

Observations from these tables are the following:

For product A, the cost of capital method is similar to the 90% confidence results. For the risk-adjusted discount rates we used above, the discount adjusted results much higher than the cost of capital or percentile methods.

For product B, the cost of capital approach is similar to a 65% confidence interval. Undiscounted reserves would have a risk margin similar to the 75th percentile. An interest rate risk adjustment of somewhat less than 2% would produce results consistent with the cost of capital method and 65th percentile risk margin levels.

Product C shows very different results for 75% confidence, undiscounted reserves and cost of capital methods. In this case the cost of capital method has the highest indicated risk margin, slightly higher even than the 90th percentile 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 from 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 Measurement—Pooling, Diversification and Reference Portfolio/Entity Concept

The statistical measurement of risk requires a context in ways that the measurement of expect values/current estimates does not. For example, the expected value per policy for a small group of policies would be the same as the expected value per policy for a larger group of similar policies. However, the risk distribution for the smaller group of policies is wider (larger coefficient of variation) and potentially more skew than the risk distribution for the larger group of polices. Combining similar risk is called pooling, and it results in a reduction in risk per policy.

Moreover, if one company has risks from two different types of policies, e.g., automobile and property risks, the risk distribution for the policies combined would have a lower skewness and coefficient of variation than the 'average' values for the two lines. In particular, percentile risk margins and the required capital for cost of capital methods would be less than the sum of the separate risk margin or capital amounts. Reducing risk by mixing different types of policies is called diversification.

Table 6.10 below shows confidence levels and capital levels (needed for cost of capital calculations) with and without the effect of pooling and diversification.

Table 6.10 – % of expected value

Context	65% confidence Level	99.5% confidence level
Line X alone		
Line Y alone		
4 x Line X (pooling)		
Line X + Line Y (diversification)		

Assumptions: Equal amounts of X and Y. no correlation between X and Y;
(Note: Even if X and Y are partly correlated, the reduction occurs, although the size of the reduction is less.)

Explicit assumption and discount-related methods appear to be independent of the context. However, in order to compare them to cost of capital or quantile methods that are risk-sensitive, we need have an understanding of the degree of pooling and diversification that they are intended to consider.

As discussed in Section 7.1, IAIS and IASB principles appear to require that the risk measurement context must be broader than that of the reporting company. The context could reflect the choice from the following possibilities:

1. Own company or own group, or
2. A scaled-up version of the reporting company or group, or
3. A standardized reference company

And, one of the following:

4. Single line of business, or
5. Multi-line, i.e. a combination of lines of business

By a 'scaled up' version of the reporting company we mean a company that is sufficiently large that the degree of 'process risk' is a low as practical in that market.

Table 6.11 below shows the reporting implications of the various choices.

Table 6.11--Risk Context Options

Reference Entity	LOB/Mix of Business	Liabilities similar across cos?	Diversification across LOB considered?
Reporting Co	Single LOB	No	No
	Co Mix of business	No[(a)]	Yes
Reporting Group	Single LOB	No	No
	Group Mix of business	No[(a)]	Yes
Scaled Up Company or Group	Single LOB	Yes	No
	Co. LOB mix	No[(a)]	Yes
Standardized Reference Co	Single LOB	Yes	No
	Ref Co. Line of business mix	Yes	Yes

(a) Two companies with identical portfolios for line of business A, but different distributions of business in other lines would have different risk margins.

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

6.7.1 Reference Company/Reference Portfolio concept

A reference company/reference portfolio would represent a standard company size and distribution of business by product used to define the risk context of the reporting company. The reference company could be thought of as a reinsurer to which the reporting company ceded its business. The risk margin for the reporting company would be the risk margin calculated by the reference company for the reporting company business.

The idea of a reference company or reference portfolio is a new issue for risk measurement. In the past, risk measurement was done only on an individual company basis. The desire to achieve consistency between companies with similar portfolios and/or consistency with market levels creates the need to define a reference company.

Because it is potentially significant and new to insurance actuarial and accounting literature, we attempt to be specific about our understanding of the possible reference company definitions. One definition of a *reference company* could be a large, multi-line, diversified, insurer with business similar in nature to the portfolios subject to the valuation.

1. "Large" means large enough that "process risk"[22], fluctuation about the expected value, is as small as practical. For many types of insurance, given that the reference company is large, process risk will be negligible compared to parameter and model risk. Process risk may be significant for some coverages, e.g., property-catastrophe and high-layer excess property or liability coverages. Parameter and model risk for the reference company is not expected to be small.
2. "Multi-line, diversified" means the realistic benefits of risk diversification across portfolios and territories (including within and between countries to the extent that such diversification is observed in the market) are recognized in determining capital, cost of capital, variability in liabilities, margin setting, and other parameters.

[22] In the IAA *Blue Book* (Global Framework for Assessment of Insurer Solvency, 2004) the concepts of "risk" and "uncertainty" are defined. Risk means the variability in outcomes in a process that is fully understood, e.g., the result of rolling a pair of fair dice. "Uncertainty" means the additional variability in outcomes that occurs because the process is not fully understand, the model used might be incorrect to some degree and/or the actual model parameters will vary from the estimated parameters. As the term "risk" is used in other ways, e.g., risk margin" in this report, the term "process risk" is used to refer to risk as defined in the *Blue Book* and "parameter and model risk" refers to uncertainty as it was defined in the *Blue Book*.

3. "Business similar in nature" means that determination of the characteristics of the reference company is based on a review of an appropriate set of companies that are in the same business.
4. For the cost of capital method, we also need to consider the financial strength rating of the insurer as it affects the target capital and the cost of capital. However, the sensitivity tests in Section 6.5.2 suggest that in at least some cases, if capital requirements and cost of capital are developed on a consistent basis, the effect on risk margins may not be significant.

As the use of a reference company that cannot be observed is relatively new, defining it may require the use of assumptions that cannot be calibrated to any the 'real world' data. Further research and discussion are required to determine the extent to which this can be usefully calibrated.

6.8 Context for Risk Measurement--Risks to be considered

The discussion and examples in sections 6.4-6.6 assumed that all relevant risks were included in the risk distributions.

For the of cost of capital method, as discussed in various forums,[23] this means all non-hedgeable risks associated with the runoff of claims/policy obligations including the risk of variability in settlement obligations amounts, reinsurance credit risk[24], and operational risk, but not including market or credit risk for assets because those are hedgeable. Assuming that is the range of risks, Table 6.12 summarizes some of the typically observed risks and identifies which are to be included in the risk distributions.

Table 6.12--Summary of Risks

Business Type	Risk type	Included?
Life	Mortality	
Life	Trend uncertainty	Yes
Life	level uncertainty	Yes
Life	volatility	Yes
Life	Calamity	Yes
Life	credit risk on reinsurance	Yes
Life	Expense	Yes
Life	Persistency	
Life	Volatility	Yes

[23] IAIS *Structures Paper* (2007), Ruygt (2006), CFO Forum (March 2006), the SST methodology.
[24] Reinsurance credit risk might be hedgeable to some extent. This provision in the risk margin should 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.

Life	Calamity	Yes
Life	Uncertainty	Yes
Life	Premium Re-rating Risk	Yes
Life	Effectiveness of reinsurance transfer	Yes
P&C	P&C	
P&C	current non-catastrophe uncertainty	Yes
P&C	current non-catastrophe volatility	Yes
P&C	current catastrophe risk	Yes
P&C	catastrophe credit risk reinsurance	Yes
P&C	claims development risk	Yes
Health/Disability	Morbidity	Yes
Health/Disability	current uncertainty	
Health/Disability	current volatility	Yes
Health/Disability	Prior	Yes
Health/Disability	Calamity	Yes
All	Operational Risk Capital	Yes
All	Credit Risk	No
All	Interest Rate Risk	No
All	Currency Risk	No
All	Real Estate Risk	No
All	Equity Risk	No

In the percentile method, for example as applied in Australia for general insurance regulatory reporting and less formally in other jurisdictions, the risk distributions relates to claim/policy obligations and does not relate to operational risk or reinsurance credit risks. However, if used as a market consistent value for general purpose financial reporting, the percentile method could be applied to the same risks as the cost of capital method. In our discussions we assume the quantile methods would be applied to risk distributions that considered the same risks as the cost of capital method.

As multiple risks are considered, it is necessary to consider the appropriate way to combine the risks. Section 6.7 discussed that issue with respect to combining numbers of risks and different lines of business. Appendix C discusses issues related to combining the different types of risks identified in table 6.12.

6.9 Risk Distributions – Liability estimation and market risk perception

Regardless of whether the risk margin is based on the cost of capital, quantile or other risk-sensitive method, a risk distribution designed for measuring an exit value one (or more) year(s) hence on contracts in force at the reporting date would need to consider variation related to (a) variations in estimates of the liability over the time period based on emerging experience, and (b) variation in the market perception of risk.

In this regard, in practice, there are two modeling approaches to determine risk margins.

One approach measures the distribution of liability estimates from year to year based on changes in experience (distribution of estimates).

A second measures approach measures the distribution of possible settlement values without regard to interim estimates (distribution of settlement amounts).

With either approach, the distribution of settlement amounts and year-to-year cash flows are generally projected. In the first approach, the model adds a feature to estimate how liabilities would be estimated based on the simulated emerging experience to date. In the second approach, the 'estimation' component is not used.

In either case, the models are used inter-changeably for one-year time horizon (e.g., thinking about capital adequate at the 99.5% confidence level over a one year time period or percentile or risk margin needed to represent an exit value one year hence) or for the risk associated with the complete run-off

The assumptions underlying these approaches could be described as follows:

1. Market risk perception is constant

2. The estimated liability at one year (or more) after the reporting date is projected to equal to either:

    a. In the liability estimation approach (approach 1)--
    The results of the liability estimation model in

    b. In the settlement value approach (approach 2)--
    The discounted expected ultimate settlement cost in, i.e., as if the liability estimation process were exactly correct

These approaches have been developed in the context of modeling capital adequacy for ongoing and runoff companies. In that context changing risk perception is not relevant and the issue of liability estimation is less significant.

These models are now suggested for use in setting cost of capital or quantile risk margins on an exit value basis. Therefore, the following issues need to be considered:

1. Market risk perception is variable. Practical and policy advice on how that should be treated in exit value risk margin modeling is needed, e.g., distributions of cost in the cost of capital method or distributions in the market perception of confidence level or CTE levels in quantile approaches.

2. Neither assumption regarding the liability estimation considers the variation is the estimation process. Practical and policy advice on how that should be treated in exit value risk margin modeling is needed.

6.10 Practical issues

Practical issues that affect risk margin approaches include the following:

Context
The most immediate practical issue is the determination of the extent to which pooling and diversification, as discussed in section 6.7, are to be considered.

Moreover, if a reference company/reference portfolio were defined, who would be responsible for the initial definition and for updating it, if necessary?

Calibration
Each of the methods requires assumptions which need to be selected by some combination of judgment and data. In that regard, we note the following:

- Disclosure and/or regulatory guidance on methods and disclosure of the resulting margins will tend to produce consistency in methods between companies over time.

- Calibration to market values, i.e., 'actual' transfer values is more problematic as there are few transfers, and many transfers relate to special circumstances. Specifically,

    - The cost of capital methods, there is observable data that appears relevant, but as discussed below in Section 6.10.1, there are no current studies showing that the available data can be used to calibrate a cost of capital model to produce

actual values at which liabilities would be transferred. Looking forward, some believe that utilizing cost of capital methods in financial reporting will facilitate transfers in the future, and such transfers will make calibration more and more reliable over time.
are

- For the quantile methods there is no observable data that now appears relevant for calibrating confidence levels, by line, to market values or theory. The decisions regarding quantile methods would therefore based on judgment rather than data.

- Similarly for explicit assumptions, there is no observable data that now appears relevant to determining whether any particular explicit assumption produces a transfer value.

- Theories like the deflator approach attempt to produce market consistent results, but at present there is limited practical literature on how to relate the deflator theory liability cash flows.

Consistency
Consistency between companies will depend on regulatory or professional guidance for standard practice and reasonable values for key parameters where market information is not accessible. These areas include the following:

- "Cost" in the Cost of capital method
- Percentile level or other quantile level for Quantile Methods
- Risk adjustments in the risk adjusted discount methods
- Selection of values for explicit assumptions

Definition of Solvency for Capital Modeling
In current capital modelling work, the test for the adequacy of total financial resources could be formulated as

a. Capital is determined so that at any time during the runoff there is a sufficient probability (e.g., 99.5%) that assets are sufficient to cover best estimate reserves and risk margins, or
b. Total assets are determined such that there is a sufficient probability (e.g., 99.5%) that the claim payouts will not exceed assets.

These two definitions produce somewhat different risk margins as described in Appendix A.3.

Method B produces a lower risk margin because it does not provide capital to protect policyholders if company is insolvent (assets less than discounted best estimate plus risk margins) before the end.

Professional guidance may be required to assure consistency.

Data

Some methods require data from sources other than the company, e.g., for reference company definition, cost of capital analysis, etc. The source must be determined.

Risk Margins and Income- Regulatory Considerations

Risk margins, along with discounting reserves, using market consistent asset values, will affect the level of reported income. While the risk margin effect is likely to be small compared to the other changes, we note that regulatory rules that use income measures may need to be re-evaluated. Two examples are discussed below.

Firstly, regulatory guidance on distributions to shareholder or policyholder based on income may need to be adjusted based on changes in the way that income is determined.

Secondly, we observe that in most jurisdictions fast growth by companies produces regulatory operating losses described as 'capital strain'. If reported income in the revised reporting regime means that capital strain no longer results from fast growth, then regulatory attention to the risks of fast growth are properly treated; for example, special consideration to whether capital models make suitable adjustments for growth risk may be appropriate.

Reliance on models

It is not possible to use capital from published financial statements to calibrate the capital in the cost of capital method. The capital held by an insurer deals with all risks and strategic choices[25]. For the cost of capital method, however, as discussed above in section 6.8, the required capital deals with only certain risks, not all risks associated with an ongoing company. Few, if any, companies show capital separately for those risks, so calibration by comparison to others is not practical. Even information on capital from run-off companies may not be relevant as they are few in

[25] Hitchcox, page 6-7

numbers and their situations usually have unique characteristics that make application to the "normal" claims situation problematic.

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

For cost of capital or percentile methods,

1. Some insurers may not be able to construct the models needed, and it may be necessary to have benchmark ratios. For capital purposes, the benchmarks might be those in standard capital requirement (SCR) being discussed in the context of Solvency II.[26] More directly for risk margins, benchmark percentile levels have been compiled in Australia.

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

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

- The CRO Forum has undertaken a benchmarking study between its members indicating that there is high level of consistency in the models used by its member companies;

- The IAIS is developing a principles based paper on internal models;

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

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

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[26] Solvency II work is attempting to construct models that separately the different risks on a line by line basis. Other regulatory capital schemes have not been done at that level of detail and care is required in determining whether capital applicable to the selected risks can be obtained from the solvency model.

6.10.1 Practical Issues with Quantile Approaches

In applying the quantile approach there are several issues to discuss:

The first issue is in the selection of the level of confidence to apply. While there is some practice in some countries, there is no theory or practice to allowance a determination of what level would constitute a transfer value.

Secondly, as shown in the examples, it might be appropriate to use different confidence levels for different products. As noted above there is yet to develop an appropriate methodology for setting an overall confidence level and splitting this by product (group) only exaggerates this difficulty.
In addition, defining different confidence level by product makes it complex to achieve global consistency.

Thirdly, during the course of claim runoff, the risk distribution may become increasingly skew, i.e., there are fewer claims and the remaining claims may be larger. So, as with differences by product, to maintain a consistent risk distribution by claim runoff year, different confidence intervals by age may be necessary.

6.10.2 Using data to determine "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, hence the "cost" in the "cost of capital method and the will depend on financial rating of the reference company (or the reporting company if no reference co is used). The financial rating will depend, all else being constant, on the amount of capital in the company.

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

In any case, the cost of capital for a base level of capitalization is required for the cost of capital method. While data on market returns appears to be readily available, it is not generally in the form needed to calibrate a cost of capital model.

The cost of capital for the cost of capital method is the before-the-event target intended to produce a desired after-the-event pre-tax return the capital as indicated in 6.10.2 in a market consistent form.

It does not refer to the firm's cost of capital, but rather to the capital needed for the unhedgeable risks. This might be determined in a number of ways including:

1. Judgment
2. Analysis of historical returns on book value
3. Market value analysis.

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

There are a number of well-known methods for establishing the first value, the market cost of capital. The Capital Asset Pricing Methodology (CAPM) is perhaps the best known. Other methods include the Arbitrage Pricing Model (of which the Market Consistent Pricing Model is one variant), multi-factor versions of CAPM of which the Fama-French 3 Factor Method (FF3M) is perhaps the most well-known, and Discounted Cash Flow (DCF) methods.[27] Unfortunately, these methods do not necessarily produce consistent results.

A market based cost of capital then needs to convert the investor expected return on market value into an internal return on capital for the reference company. The issue is discussed in depth in Hitchcox (2006) and Swiss Re (2005). As with the cost of capital analysis, results vary. This report does not contain a recommendation concerning the proper level of cost. Rather, its examples are for illustrative purpose only, using costs that have been used by others for this purpose. Observations regarding the cost of capital follow:

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

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

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

3. Recent literature on market cost of capital includes Sigma (2005), and Cummins and Phillips (2005). Recent literature on converting market cost of capital into pre-tax return on book value that can be required to be used as a starting point for the calculation of the cost of capital method include Feldblum (2006), Hitchcox (2006) and Sigma (2005). Note that these models generally reflect the firm's cost of capital and its franchise value.

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

Various parties, including the IAA, have volunteered to participate in work to help determine an appropriate method for establishing cost of capital for purposes of determining the risk margin.

6.11 Analysis of Approaches--Qualitative

This section compares the alternative risk margin approaches against a number of criteria.

- Complies with five IAIS guidelines- section 6.2
- Complies with additional RMWG guidelines- section 6.2
- Ease of calculation
- Market consistent
- Earnings criteria- section 6.2
- Consistency between classes of business
- Consistent with regulatory solvency and other objectives
- Consistent with IASB objectives

The criteria are considered one at a time. In each section below, the strengths and weaknesses of each of the methods relative to the one criterion are discussed. At the end of this section, we summarize our discussion in a table.

It is beyond the scope of this paper to select a method, as that requires various policy decisions.

Complies with the five IAIS guidelines- Section 6.2

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

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

The cost of capital method would generally satisfy all five tests. Specifically, reasonable risk distributions will produce larger capital requirements in the higher risk examples for situations (a) to (c) and (e), and therefore the risk margins will be higher. With respect to situation (d), the cost of capital method will produce higher risk margins when applied over longer timeframes because the cost of capital will be applied for the longer timeframe.

The percentile method does not necessarily satisfy these tests. For situations (a) to (c) and (e), our examples in Section 6.5 showed that wider and more skewed distributions produce risk margins that include fewer standard deviations of (and therefore relatively less increase in) risk margin. For severely skewed distributions, the method produces risk margins that decrease as the distribution becomes more skew.

However, these tests would be satisfied by Quantile methods based on conditional tail variation if risk margins equaled a fixed number of standard deviations.

None of the quantile tests directly satisfy test c. The risk margin does not necessarily increase as the contract term increases. However, longer contract terms tend to have wider risk distributions, and to that extent the test would be satisfied.

Discount methods satisfy test c directly. The methods would satisfy the other tests only to the extent that interest rate risk adjustments were selected for the different risk profiles so as to consider the risk variation.

Explicit or implicit assumptions could be constructed to address the criteria, but would not necessarily satisfy any of the methods.

Complies with additional RMWG guidelines- section 6.2

The first two tests are:

a. Have a consistent basis at issue and subsequent to issue, i.e., for the entire lifetime of the contract;

b. Use underlying assumptions consistent with those used in the determination of the corresponding current estimates;

All five methods could be applied to have a consistent basis at issue and subsequently. Moreover, to the extent that each of the methods utilizes assumptions relevant to current estimates, they can be implemented in a manner consistent with emerging experience as the experience affects the current estimates.

The remaining two tests are:

c. Have a consistent risk margin methodology with other financial contracts; and

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

Only the cost of capital method has a theoretical basis consistent with methodologies used for other financial contracts and economic principles.

Whether the theory produces exit values as are intended to produce cannot be determined for insurance liabilities as there are limited relevant transactions against which to test the results.

There is no theory for the other methods that would connect them to valuation of financial contracts or to economic pricing methodologies.

The cost of capital methodology is an actuarial pricing approach. The other methodologies are not. However, percentile information is also sometimes considered in liability runoff transactions.

Ease of calculation

For ease of calculation, we take mechanical application of formulas or models that require no judgmental inputs as 'easier than methods that require judgment in addition to calculations. Methods that require less simulation of future results we take as easier than methods that require more extensive simulation of future results.

While there are simplifications that could be applied to some of these methods, e.g., use of SCR in the cost of capital approach and use of benchmark percentiles for the percentile approach, this section considers the ease of calculation with respect to full implementation of the method.

The cost of capital method is the most difficult to apply. For example, consider the quantile methods first. In that family of methods, at each reporting date we need a risk distribution to determine quantile levels at the reporting date. If it takes n years for obligations to settle, we will need 'n" (one for each year) risk distributions over the course of the runoff.

Now, consider the cost of capital method. At each reporting date we need the risk distributions required to determine the capital levels at the reporting data and at each subsequent reporting date. For the first year we need 'n" distributions. For the second year we need "n-1" distributions, 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 qunatile method and 110/2 or 55 risk distributions in the cost of capital method.

In part, the relative difficulty of the cost of capital method is offset because companies may need models for capital assessment purposes under new solvency requirements. However, the need to determine capital at future reporting dates is part of the risk margin process and not part of the emerging solvency standards**.**

The methods of determining of the 'cost' in the cost of capital method have not been established. It would be easy if the cost were determined by regulation, as is done for the Swiss solvency test, or if the cost did not require routine adjustments. On the other hand, it might involve extensive calculation and application of judgments.

The quantile methods are the next most difficult to apply. As discussed above, the method needs a model for the risk distribution at the reporting date. This makes it more difficult to apply than explicit assumptions, and possibly more difficult to apply than risk adjusted discount methods. It

does not need a projection of risk distribution for subsequent reporting dates. That makes it easier to apply than the cost of capital method**.**

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

Explicit assumptions could be very simple to apply.

Market consistent

In part, we interpret this be the same as the two additional IAA RMWG criteria discussed above:

c. Have a consistent risk margin methodology with other financial contracts; and
d. Where possible, be determined in a manner consistent with accepted economic and actuarial pricing methodologies.

The comparison on those criteria was discussed above.

In addition, market consistent means the method produces transfer values used in the market. The cost of capital method is the only method designed to achieve this objective.

However, there is no data that allows us to determine whether any particular calibration of the method does produce transfer values. This means that (until there is a market for insurance liabilities against which the models can be validated), capital standards should be set to reflect the full run-off of the insurer obligations, as would be the case for long-term non-liquid assets in other financial institutions.

Earnings criteria- section 6.2

The first earnings criterion is as follows:

a. Provides up-to-date information about earnings from current business and the difference between actual and expected results from obligations not yet settled.

There three points to consider about this criterion.

Firstly, all of the methods will change the amount of risk margin to some degree as current estimates change in response to emerging experience.

Secondly, it is important that the risk margin as a percentage of the current estimate can respond to emerging experience. The degree of response in will vary by method. The cost of capital and quantile methods will respond to changes in risk distribution. The cost of capital method will also change in response to changing payment patterns. The risk adjusted discount rate methods might respond, depending on how the risk adjustments are determined. Undiscounted reserves will not respond to any factor other than change in payment pattern.

Thirdly, the criterion seeks a response to the characteristics of new business. This is theoretically possible for the cost of capital and percentile methods as described and perhaps theoretically possible for the risk-adjusted discount method. However, 'getting it right' for new business will be particularly difficult, especially if there are changes in the nature of the business.

Explicit assumptions might satisfy some of these criteria, depending on how they are structured.

The second and third earnings criteria are as follows:

b. Is consistent between reporting periods for each company.
c. Is consistent between companies at each reporting date

Any of the methods could be designed to be consistent from period to period by company. However, some of the methods require fewer assumptions and judgments. It is more difficult to assure consistency over time and between methods as more judgments are required.

As discussed above, the cost of capital method is the most complex to implement, and so the greatest care would be required to achieve consistency from reporting period to reporting period and consistency between companies.

Percentile methods would be second most difficult.

For risk adjusted discount methods, as with ease of calculations, consistency would be easy or more difficult, depending on the detail involved in the risk adjustment.

It might be simple to assure consistency for methods based on explicit assumptions.

The fourth earnings criterion is as follows:

d. Shows earnings only when they are sufficiently reliable to provide users of financial statements with guidance useful for making decisions.

From a shareholder perspective, we observe that to the extent the earnings reflect market consistent information they can be considered useful. As discussed in the 'market consistent' section, the cost of capital method is the only one designed for market consistency.

From a regulatory perspective, market consistent information is also useful.

Consistency between classes of business

Consistency for this purpose means differences that risk margin differences are consistent with the five IAIS objectives regarding risk distributions.

If capital is assessed on a consistent basis between lines of business then the cost of capital method is designed to achieve consistency.

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

Risk adjusted discount rates would be consistent between classes if the risk adjustment were selected appropriately. The use of undiscounted reserves would not achieve consistency.

Explicit assumptions might be designed to achieve consistency, but it is not automatic.

Summary

To the extent we considered practical, the following table summarizes the prior discussion by ranking how the methods could achieve the objectives. (1)= best meets the criteria: (4) = least meets the criteria.

Table 6.15—Comparison of risk Margin Methods

Issue	Cost of capital	Quantile	Discount	Explicit Assumptions
Complies with five IAIS guidelines- section 6.2	1	2	3	4
Complies with additional RMWG guidelines- section 6.2	1	2	3	4
Market consistent- in theory	1	NA	NA	Na
Market consistent- in practice	Unknown	Unknown	Unknown	Unknown
Ease of calculation	4	3	2	1
Earnings criteria- section 6.2	1	2	3	3
Consistency between classes of business	1	2	3	4

7. Risk Mitigation Techniques

In paragraphs 30 – 33 of the IAIS *Second Liabilities Paper*, the concept of "Allowance for pooling of risk" is considered. On pages 4 and 5 of its May 19, 2006 letter to the IAIS concerning the then draft *Second Liabilities Paper*, the IAA raised the somewhat broader issues of "offsetting risk", "diversification" and "reinsurance" in addition to "pooling". The IAA noted that there should be further discussion of how to handle these various risk mitigation techniques in the measurement of liabilities of insurance contracts and in total financial resources. Sections 7.1 through 7.5 contain such discussion.

In the meantime, it has become apparent that the issue of risk concentration (i.e., the opposite of risk diversification) should be considered at the same time and it is addressed in Section 7.6. Note that a "pool" and a "portfolio of obligations" are used here synonymously.

Each issue addressed in this section is discussed from the perspective of the reporting entity for the measurement of liabilities. If a reference entity is used to determine risk margins, in whole or in part, then it is also addressed from the perspective of the reference entity.

7.1 Pooling

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

Open questions with respect to pooling include the extent to which a lack of pooling should be reflected and how it should be reflected. This has been the subject of considerable discussion at IAIS committee meetings.

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

The objective expressed in the *Second Liabilities Paper* could be interpreted to mean that a similar-sized pools of similar obligations with

similar risk profiles would result in similar liabilities. In this case, the risk margin for a pool of obligations should reflect the credibility of the actuarial data available, derived either from the pool itself or from other sources but relevant to the pool.

In contrast, the IASB has currently indicated that if a price for risk can be observed, it should be reflected in the value of liabilities. Therefore, to the extent that the market includes a price for a smaller portfolio, this price would be included in the risk margin. If, however, efficient markets did exist, the measurement of a transfer price of a pool of obligations would not be relevant. The use of a common reference entity (see section 6.9.2 for further discussion) eliminates the need to reflect the process risk associated with a small portfolio. Further research and discussion may be warranted in this area.

7.2 Reinsurance

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

In its May 2006 meeting, the IASB Board considered this issue further as recorded in the IASB *Update*.

> "The Board discussed approaches to accounting for reinsurance contracts, and tentatively decided:
> - The measurement attribute for reinsurance assumed (inwards reinsurance) should be current exit value.
> - The measurement attribute for reinsurance assets (outwards reinsurance) should be current exit value.
> - For risks associated with the underlying insurance contract, a risk adjustment typically increases the measurement of the reinsurance asset, and is equal in amount to the risk adjustment for the corresponding portion of the underlying insurance contract. The Board noted that the conclusion on risk adjustments for reinsurance assets may also be relevant when the Board considers policyholder accounting after the Discussion Paper stage of the project.
> - The carrying amount of reinsurance assets should be reduced by the expected (probability-weighted) present value of losses from default or disputes, with a further reduction for the margin that market participants would require to compensate them for bearing the risk that defaults or disputes exceed expected value.

- Given the Board's preference for using current exit value as the measurement attribute for insurance contracts, there is no need to restrict the recognition of gains or losses when an insurer buys reinsurance.
- A cedant should recognize at current exit value its contractual right, if any, to obtain reinsurance for contracts that it has not yet issued. In practice, that current exit value may not be material if the cedant's contractual right relates to insurance contracts that will be priced at current exit value."

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

Both the IASB and the IAIS appear to have recognized the desirability of incorporating risk margins that directly reflect the term and tail[28] of the risk assumed.

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

If not measured consistently, the reference entity might be different for the net or gross of reinsurance portions.

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

7.3 Offsetting risks

Offsetting risks is a risk mitigation technique that uses the negative correlation of the uncertainty associated with a second set of obligations or rights to reduce the risk for a first set of obligations or rights. A well-known example would be whole life insurance contracts and whole life payout annuity contracts. The level of mortality for life insurance is different from the level of mortality for life annuities, reflecting both selection and anti-selection. However, the trends in mortality for insured lives and annuitants are highly correlated. 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 product.

There are two alternatives. The first is to ignore any risk mitigation effects in the measurement of the respective liabilities. The second is to reflect an appropriate reduction of volatility in each set of risk margin calculations for insurance and annuity liabilities. A discussion of the three main methods of risk mitigation (pooling, diversification, and hedging) is included elsewhere in Section 7.

The IASB's current *Framework* seems to imply that effects at a higher level than the level of similar risks that are similarly managed, should not be reflected in the measurement of the liability. The reason for this is that the effect of off-setting risks would not be reflected in transaction prices by market participants. Treated thus, it would be reflected only as a reduction in capital requirements. Note that this view is not shared by all observers. This approach is consistent with the objective expressed in its *Second Liabilities Paper* of consistent methodologies for both general purpose and regulatory financial reporting purposes.

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

7.4 Risk diversification

A risk or portfolio of risks is diversifiable if it is of sufficient size and type for which there are sufficient uncorrelated but dissimilar risks available to reduce the fluctuations caused by the risk or type of risk in a diversified

portfolio so that the variability of the total portfolio is less than the variability of each component added together.

If the decision with respect to off-setting risks is to measure the liabilities of insurance contracts independently, there is no case to be made for considering another option with respect to reflecting diversification benefits in liability measurement.

If the decision with respect to off-setting risks is to reflect their effect in the calculation of the risk margins that demonstrably reduce uncertainty and risk, the issue remains open with respect to reflecting diversification benefits in liability measurement. This is because the benefits from diversification do not arise from similar contingencies.

The concept of permitting diversification benefits to spill so far over the "unit of account" or portfolio when calculating insurance liabilities may be somewhat controversial. This may make it more difficult to obtain consistent general purpose and regulatory financial reporting methodologies. Nevertheless, to extent that market participants are well-diversified entities, observable prices would reflect such effects.

There is no actuarial reason for excluding diversification benefits in the determination of total financial resource requirements. Nor is there an actuarial reason for excluding diversification benefits in the measurement of liabilities. Note that some reflection of diversification is unavoidable, as no two exposures are perfectly identical. A portfolio of life insurance contracts, for example, will diversify by including a mix of insureds, occupations or regions. As a result, the key issue is the extent of diversification to be recognized and not whether or not it should be recognized.

7.5 Contract adaptability features

Many insurance contracts, in some markets practically all life insurance contracts, include features that permit the insurer to modify the cash flows otherwise due after issue in response to subsequent experience. This may apply to either or both of cash inflows and outflows. These features include policyholder dividends and bonuses, contract charges, fees, credit interest and adjustments to premiums and policy benefits. In some cases the contact features may involve amounts payable to people other than policyholders; profit commission is an example.

The modifications can have a direct contractual relationship to subsequent experience or can be subject to considerable discretion. Discretion can be limited by means of initial or subsequent contract illustrations provided to the policyholder, dividend resolutions by the entity's boards of directors,

regulatory approval or competitive pressures. It could be debated whether or not the amounts not guaranteed can be categorized as a component of the current liability. They may, for example, be treated as a constructive obligation. This has been a very controversial issue for setters of financial reporting standards.

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

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

The complexity and wide variety of such features can result in significant recognition issues. While the preliminary view of the IASB is that liabilities in general purpose financial reporting should be based on the amounts an entity has a legal or constructive obligation to pay, the liabilities and total financial resource requirements for regulatory purposes may provide for possible action in financial emergency situations. Hence, amounts under participation or contract adjustment features that are available to cover losses in the case of financial emergency but which otherwise would inure to the benefit of policyholders may be recognized as a liability in general purpose financial reports by reducing the size of the risk margin, but would be capital from a regulatory viewpoint. To date, agreement has not yet been reached on recognition of the effect of many of these features.

The binding force of these features might result from contract terms, applicable law, regulatory action, fiduciary position or other sources. In some circumstances, the line between an obligation to pay amounts and discretion can become quite blurred. Insurers often act as if required to do so, without testing the extent to which an obligation exists, legally or otherwise, especially if the obligation might be based on views of the regulatory authority. In case of regulatory reporting, such binding force can be easier to identify than in general purpose financial reporting, since the regulator whose existing requirements can be identified and his actions

anticipated. If the actual obligation forces the entity to forward parts of the surplus generated to policyholders, but grants the insurer the option to charge exorbitant premiums or even to retroactively adjust premiums or benefits, this reduction of the ultimate risk should be considered for measurement for both general purpose and regulatory financial reports.

Features where benefits are less strictly bound to surplus and are still significantly subject to insurer's discretion, can be assumed not to be paid in highly adverse situations. Therefore, such future benefits, although expected to be paid in the normal course of business, may not be part of liabilities. Past surplus still subject to future discretionary distribution decisions is reflected as overall available resources. Performance-linked features can provide allocated past surplus that might be subject to future performance that is not yet irrevocably allocated.

The preliminary views of the IASB indicate that the reporting entity should reflect its best estimate of those benefits it has a legal or constructive obligation to pay. Such benefits cause a conflict between the principle that only present obligations cause a liability and a realistic view of the future. That conflict is also expressed by the economic trigger of such payments, the competitive situation, although other compelling reasons may exist at the same time. Ignoring discretionary but expected benefits in measuring the liability would result in reporting profitability which does not reflect economic reality.

The measurement of such features depends on their nature. They range from obligations expressed as a specified amount determined by a formula to those granted on a completely discretionary basis. In between these two extremes, amounts might be determine by reference to an external index, the accumulated surplus or deficit arising from a group of contracts or expectations raised by benefit illustrations, for example. In some cases, such as term insurance sold at premium levels far less than those guaranteed as a maximum level (the maximum of which might have been set to avoid holding additional regulatory liabilities), the difference is not expected to be charged in the future; if they were, not only would significant shock voluntary terminations likely occur, but the entity's franchise value would as well.

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

7.6 Risk concentration

Little attention has been paid to concentration of risks so far in this paper. The IAA believes that just as diversification of risks should be considered in determining the total financial resources objective so too should risk concentration.

Geographic concentration of risk can be easily recognized, but potentially a difficult one to reflect. Obvious examples are geographic concentration of hurricane, earthquake, workers compensation, business interruption or life insurance risks.

The underlying issue is often whether insured events that are normally thought of as independent are not. For example, a tornado may kill many people in one location and a terrorist action may cause significant business interruption claims in a small area (as in the World Trade Center). Similarly, a single judicial ruling may affect a significant portfolio of a non-life insurer's claim liabilities if it is concentrated in the market or jurisdiction affected by the ruling.

In its *Blue Book*, the IAA indicated that one of the purposes of capital and surplus was to absorb the effect of “catastrophes." Thus, it would be a feature of a capital model, just as would great degrees of uncertainty. However, the question remains as to what is significant enough to qualify as a “catastrophe”?

Multiple deaths from a tornado would not seem to qualify. Indeed, re-insurance against just such a contingency can often be readily obtained. Hurricanes happen every year, although their effect on insurance loss can vary considerably. Is there a threshold at which a hurricane becomes a “catastrophe”?

The IASB has decided that “catastrophe reserves” cannot be recognized as liabilities, as such a provision simply was an accumulation of past premiums and did not bear any particular relation to the future expectation of risks. This amount typically was available to smooth earnings, recognizing a portion of a past premium as a future "smoothing" reserve that could be used to offset the effect of a future catastrophe. However, such a liability directly related to the risks associated with an unexpired term of the insurance obligation for which premiums have been paid yet not earned remains appropriate.

The IAA believes that reflecting risk diversification in required total financial resource requirements is not independent of the reflection of risk concentration. Risk diversification is a statistical concept of proven validity with respect to risk management. Similarly, risk concentration also is of proven relevance to insurer solvency assessment. The probability

distributions considered in both risk margins and capital should reflect the potential for catastrophes, although not necessarily that in different risk pools.

It is the opinion of the IAA that the issues of risk diversification credits and risk concentration debits to required total balance sheet resources should be examined in tandem.

It has been beyond the scope of the IAA discussions to date to do more than “flag” the issue of consistent treatment of risk diversification and risk concentration.

8. Other Issues

8.1 Service margins

The IASB has proposed that the liability for insurance contracts include a margin for services provided by an insurer not related to insurance risks in addition to the current estimate and risk margins. Such a margin would represent the compensation required by a third party or a market participant to provide such services, such as investment management services, as long as market participants typically require such a margin. This can take the form of a fee for the service provided. Its stated objective is to avoid the front-ending of expected profit for such services. It reflects the difference between the profit portion of the price that would be charged by market participants to provide such services in addition to the already considered current estimate and risk margin.

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

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

Element 4 is the component that led the IASB Board to include a separate margin for services in liabilities in its Discussion Paper. Another motivation is an attempt to treat the service component of an insurance contract consistent with the current approach used in IAS 18. The problem with this approach is that in most cases its amount in a bundled insurance contract is indistinguishable from that of elements 2) and 3) above and from insurance risk incorporated in the risk margin. Although in certain cases a distinct charge for profit may be measurable (asset management service provided through a mutual fund with transparent expenses and charges may be one, although even in this case the risk margin cannot easily be discerned).

To the extent not observable, it may not be practical to determine or model this charge for profit separately in a non-arbitrary manner. However, it may be possible to reflect this charge for profit to the extent that a risk margin can be constructed to provide for it. Otherwise, it may be more appropriate to reflect this as part of capital or if the no profit at issue constraint is applied, it would be included there.

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

8.2 Margins under a "no profit at issue constraint"

This section discusses an alternative role for margins in the context of a different measurement objective for liabilities. At present, both the IASB and the IAIS are leaning toward general purpose and regulatory financial reporting for insurance contracts based upon exit values that permits "profit on issue." However, an entry price accounting objective is still being considered. If "profits at issue" are not allowed to be recognized, a total margin approach, rather than a standard incorporating risk margins would be used.

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

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

- Follow one of the risk margin approaches described in Section 6. This would result in the amount withheld as profit at issue flowing immediately back into profits, which would defeat the objective of the constraint.
- Calibrate the total margin that would have produced the profit at issue and maintain that total margin for calibration purposes at subsequent measurement dates until there is reliable statistical evidence that either the current estimate of the liability has decreased significantly or the probability distribution of the insurance liabilities has become "better

behaved". The determination of what constitutes reliable statistical evidence is an issue that would require further investigation.

- Calibrate the total initial margin to represent an equivalent confidence level or cost of capital, with subsequent adjustments made only when the price of risk demonstrably changes, consistent with the current entry approach.
- Calibrate the total initial margin, to be worn off on a release-from-risk basis, with the risk margin otherwise calculated being grossed up by a factor equal to the ratio of the initial total break-even margin to the otherwise calculated initial risk margin.
- Calibrate the total initial margin, to be released in proportion to the major profit drivers of the contract, such as is currently used in Australia for life insurance in a Margin on Services approach..

8.3 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 insurer's liabilities, while the IASB, considering that these risks are faced by any owner of such a portfolio, requires them to be considered in the liability for insurance contracts.

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

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

8.4 Governance

A discussion of relevant governance issues surrounding the measurement of liabilities for insurance contracts is outside the scope of this paper. They are important, and encompass controls surrounding every element of the process of development relevant measurements and appropriate validation of the reasonableness of the data and experience studies relied upon, assumptions made and resulting estimates.

Even though actuaries may not be responsible for measurement, they usually are involved in carrying out this responsibility, as it is common to

rely on experts such as actuaries for this purpose. As such, transparency in documentation and presentation of measurement estimates is important.

Appendix A—Statistical Background and Product Assumptions

A.1 Coverage and risk distributions

The principal drivers of risk margins using the methods discussed in section 6 are the time it takes to settle claims/policy obligations distribution (risk distribution) of possible final settlement. Table A.1 shows three patterns of life insurance and three for general insurance that have been selected for our examples.

Table A-.1 Coverage and runoff periods
Discounted Current Estimates at the Beginning of the Year

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

We also selected four risk distributions that are broadly representative of (a) policy obligations for simple life products, (b) unpaid claim obligations for motor insurance, (c) unpaid claim obligations for risky liability/low risk reinsurance and (d) pre-even cover (unearned premium) for extreme events. These are represented by risk distributions with skewness (γ) = 0.20, 0.40, 0.80 and 8.0.

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

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

Chart A.2a Probability distribution functions for distributions with gamma 0.0, 0.20, 0.40, and 0.80

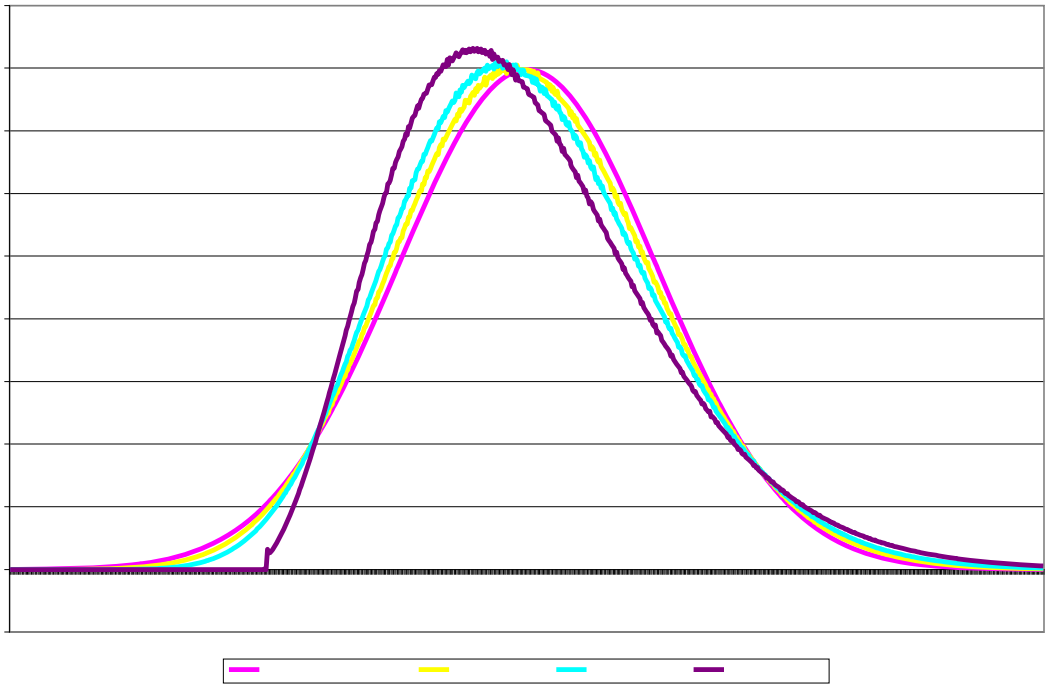
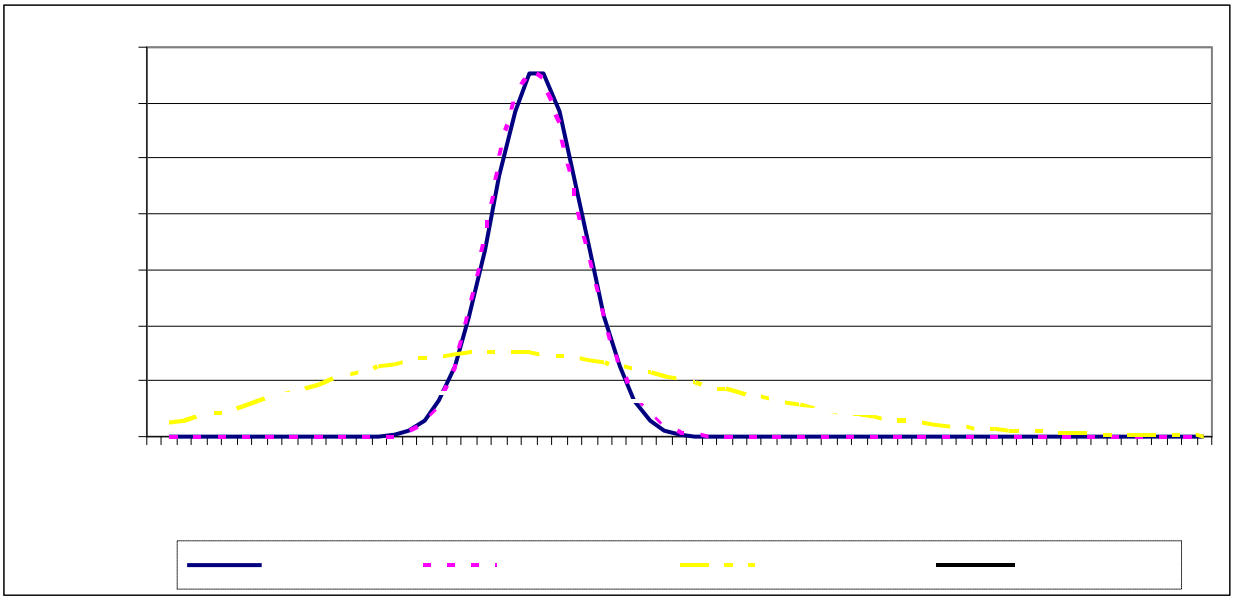


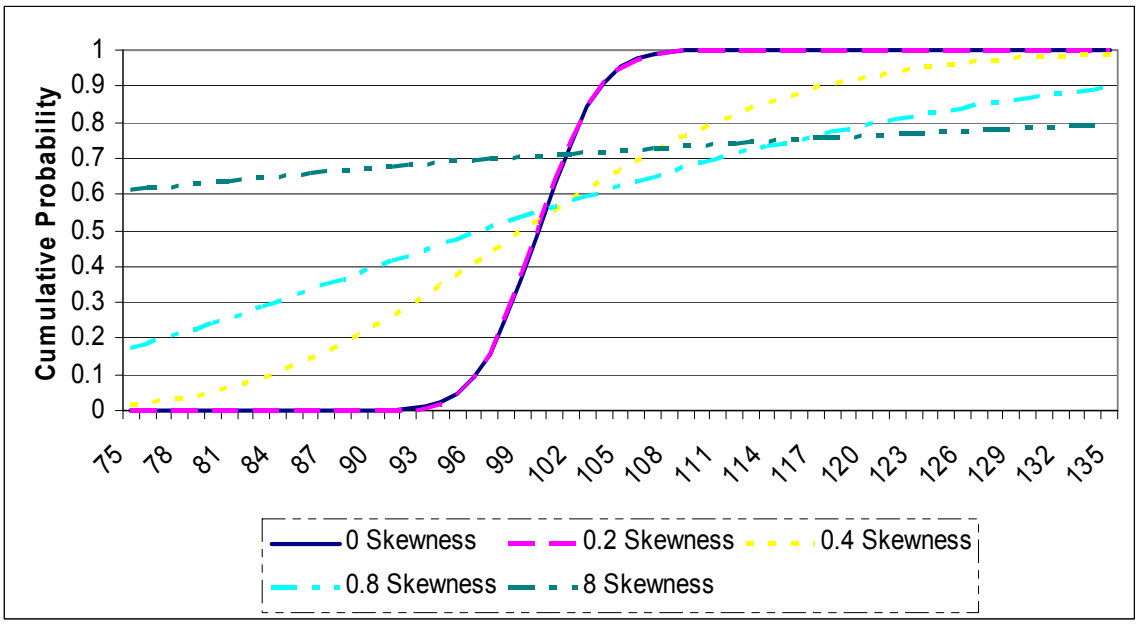
Chart A.2b shows the distribution for products A-C when adjusted to have the same mean. It also shows the normal distribution with same mean and coefficient of variation as the 0.2 skewness curve. The normal and product A curves are nearly identical, and cannot be readily distinguished on the chart.

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



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

Chart A-3: Cumulative probability functions— For various levels of skewness



Limitations

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

A.2 Conditional Tail Expectation

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

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

The mathematical definition is

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

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

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

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

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

A.3 Minimum Capital Requirements and Cost of Capital Formulas

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

Test A – consistent with the way the Swiss Solvency Test works

- Capital is determined so that at any time during the runoff there is a sufficient probability (e.g., 99.5%) that assets are sufficient to cover best estimate reserves and risk margins
- The risk margin is separately determined from the SST formula used in Section 3.
- Determining the get risk margin may require iteration as capital depends on risk margin and risk margin depends on capital.

This can be described by the following formula

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

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

- i = Risk-free rate of return on investments (e.g., 4% in our examples)
- r = Total rate of return demanded by investors for taking 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 to (or allocated to) support an insurance portfolio at time t.

- t=0 is the reporting date; t=1 is the end of the first year, etc.

This test is consistent with 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 -consistent with the way we calculate capital in this section

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

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

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

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

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

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

This equation implies.

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

Test A requires more total assets than Test B for several reasons. Firstly, in Test A capital needs to be sufficient to assure that assets cover risk margins as well as discounted liabilities during the course of the runoff. As solvency generally means assets exceed liabilities (including risk margins), Test A covers solvency through the course of runoff while, under Test B a company could pass even it were insolvent during some part of the claim runoff.

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

Test B, however, is the way that UK ICAS calculations tend to work.

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

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

Table A.4-Risk margins—SST and CCF formulations

Model	Test A	Test B

A. 4 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 D.5 below compares several percentile levels for two distributions similar to the ones used in our illustrations.

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

Probability	CV = 0.139; gamma = 0.42			CV = 0.307; gamma = 0.95		
	Excess over mean			Excess over mean		
	Lognormal	Normal power approximation	% Diff	Lognormal	Normal power approximation	% Diff
65.00%	0.322	0.326	1.29%	0.238	0.251	5.12%
90.00	1.314	1.326	0.98	1.317	1.383	5.02
99.50	2.982	2.970	-0.40	3.488	3.468	-0.59
99.90	3.732	3.688	-1.18	4.615	4.444	-3.70
99.95	4.039	3.978	-1.52	5.102	4.846	-5.01

The skewness (gamma) of the lognormal distribution is

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

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

Where sigma is the standard deviation of the normal distribution which has been transformed into the lognormal distribution.

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

CV^3 + 3*CV – gamma = 0

For gamma = 0.25, CV=
For gamma = 0.42, CV= 0.139
For gamma = 0.95, CV= 0.307

These values can easily be tested. In general, http://www.1728.com/cubic.htm has formulas and a routine to solve cubic equations.

APPENDIX B – Life Insurance and Annuity Risk Margin Examples

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

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

In this example, the risk margins for a single premium annuity whose payout is guaranteed for the whole of life are calculated based on the cost of capital method. The annuities are for a portfolio 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).

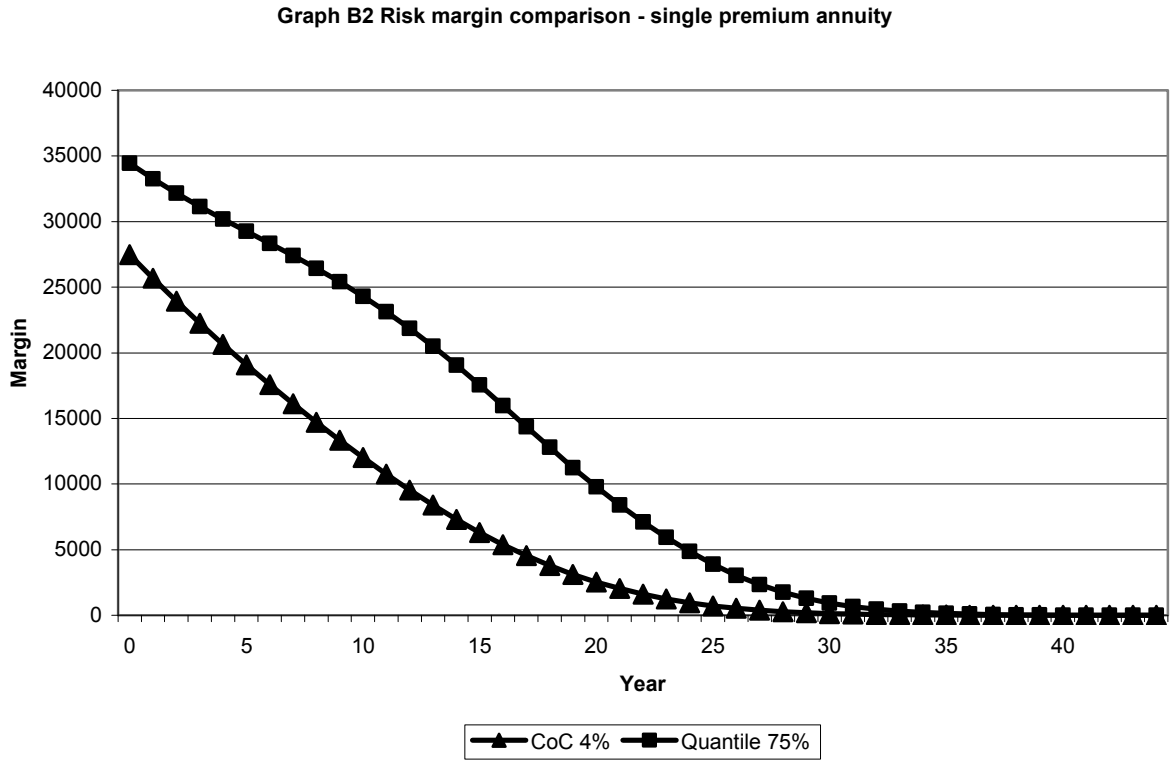
A short overview of how the calculations were prepared is given below.

The calculations themselves are relatively complex, but the results for the annuity show that it is relatively easy to find a simple standard model for the projection of economic capital. It looks as if the pattern of this capital is almost linear. Further investigation is needed to confirm that this pattern applies to other products.

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

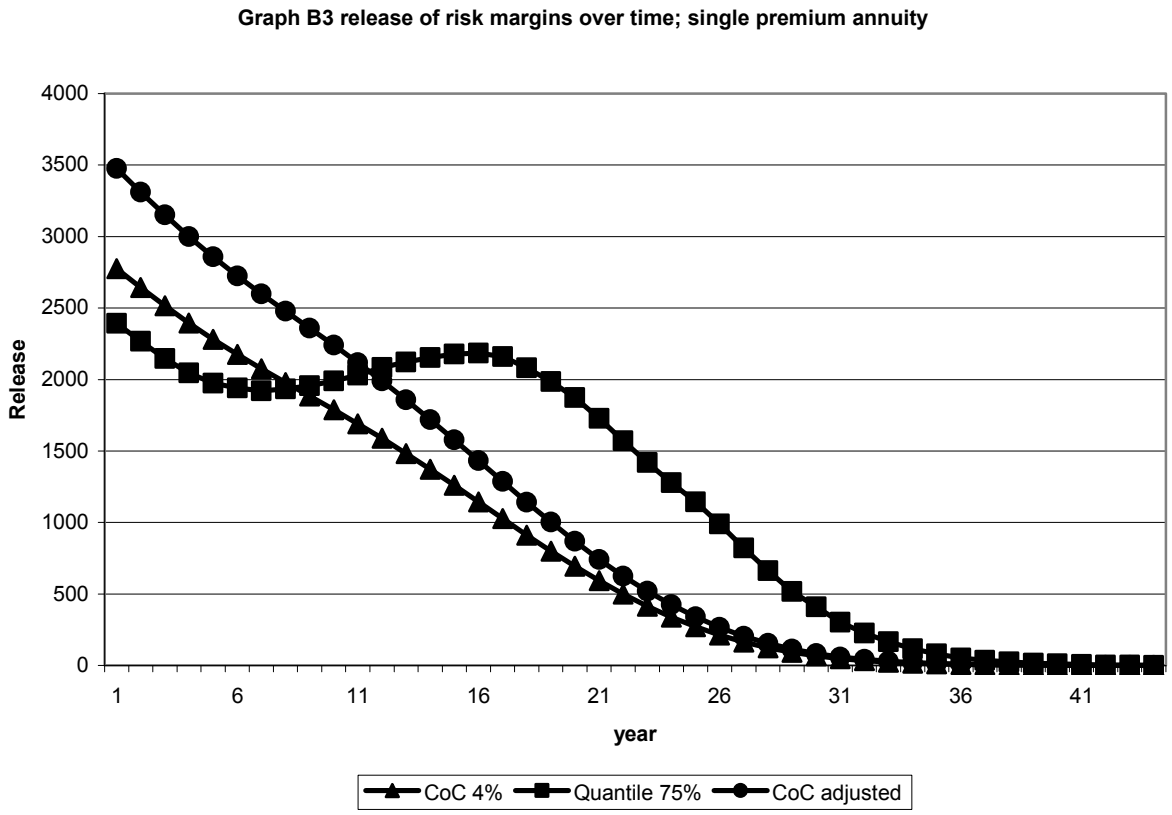
The risk margin for an annuity for a 65 year old male is 1.09% of the current estimate for a AA rated company. The risk margin derived from the 75% quantile method is much higher (1.39%). The primary reason for the difference is the approach needed to determine the parameters. It is useful to examine how the risk margins develop as a percentage of the then current estimate over time, as indicated in Graph B.2.

Graph B.2 Risk margin comparison – single premium annuity



In Graph B.3 the release of the risk margin is shown, starting at the same level of risk margin for ease of comparison. The initial adjusted result is equivalent to the application of the cost of capital method at a 4.78% discount rate rather than at 3.5%.

Graph B.3 Release of risk margins over time with consistent initial values single premium annuity



As can be seen, for this example the release of 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). It is important to 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 lower profit later, similar to the original lower cost of capital calculated at 4%.

Detailed results by year for the two methods are presented in Tables B.4 and B.5.

Table B.4 Risk margin based on cost of capital of a AA rated company single premium annuity

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

Table B.5 Risk margin based on 75% quantile – single premium annuity

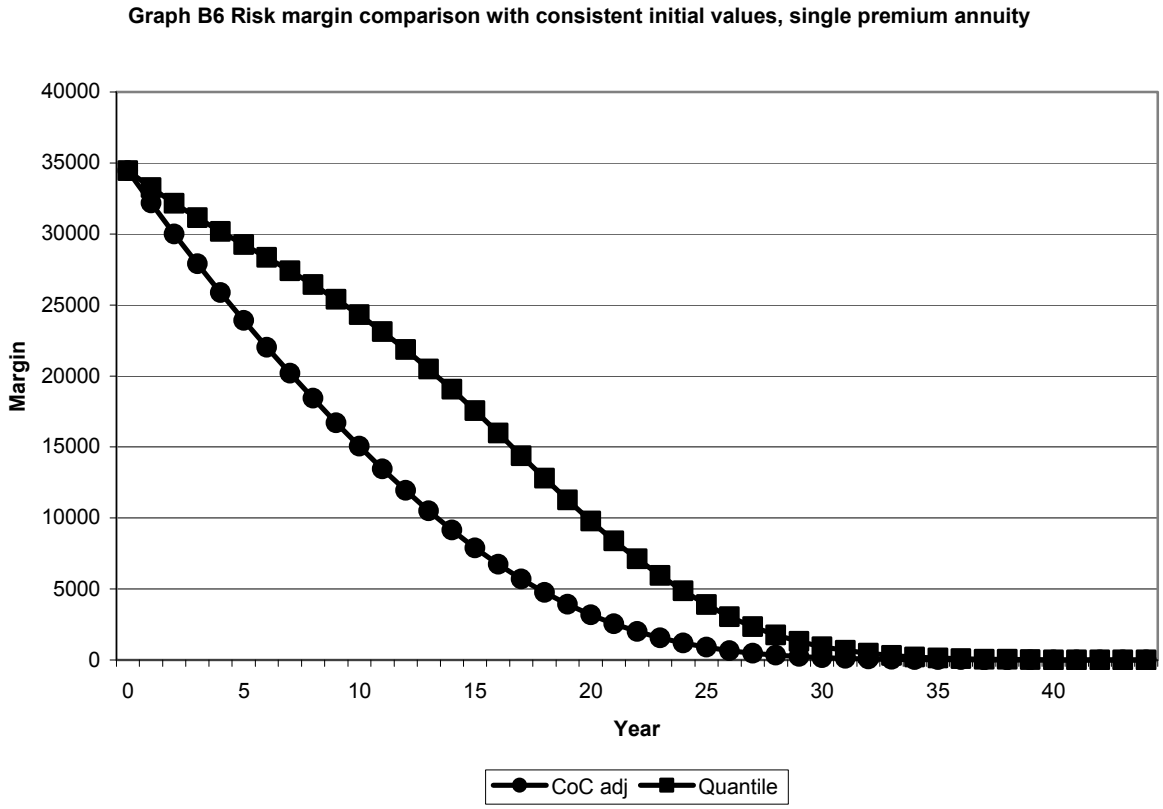
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
								=(7)+(2)	=(7)/(2)
				Square root of sum of squares					
Year	Liability Current estimate	Stand Alone Trend	Stand Alone Level	Stand Alone Expense	Stand Alone Operational	Total Risk margin	Release Risk Margin	MVL	=% (2)
0	2500000	15489	30471	3844	1825	34445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

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

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

of comparison, see Graph B.6 for a comparison of the trend in risk margins over time with these equal initial margins.

Graph B.6 Risk margin comparisons with consistent initial values single premium annuity



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

B2 Example – Risk margins for a term life insurance contract

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

mortality (absolute) of 0.15% to 0.25%, independent of age and gender. In this example, 0.15% is used. Translations to other confidence levels are based on the Pareto distribution. The estimated effects of diversification relating to the components of mortality and mortality related risk are given in Table B.7.

Table B.7 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 to this example are given in Tables B.8 and B.9.

Table B.8 Cost of capital method based on a AA rated company – term life insurance

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

Table B.9 Quantile method based on 75% quantile – term life insurance

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

As above, the quantile and the cost of capital methods are not completely comparable. To equate the starting level of the cost of capital method to that of the 75% quantile, we had to increase the cost of capital from 4% to 8%. Again, this is only the case in this example. Other age/duration combinations would lead to other percentages. In Graphs B.10 and B.11,

the development over time of the "adjusted" cost of capital and the 75% quantile method is shown.

It is clear that the release of the risk margin over time based on these two methods is not the same.

Graph B.10 Risk margin comparison with consistent initial values – term life insurance

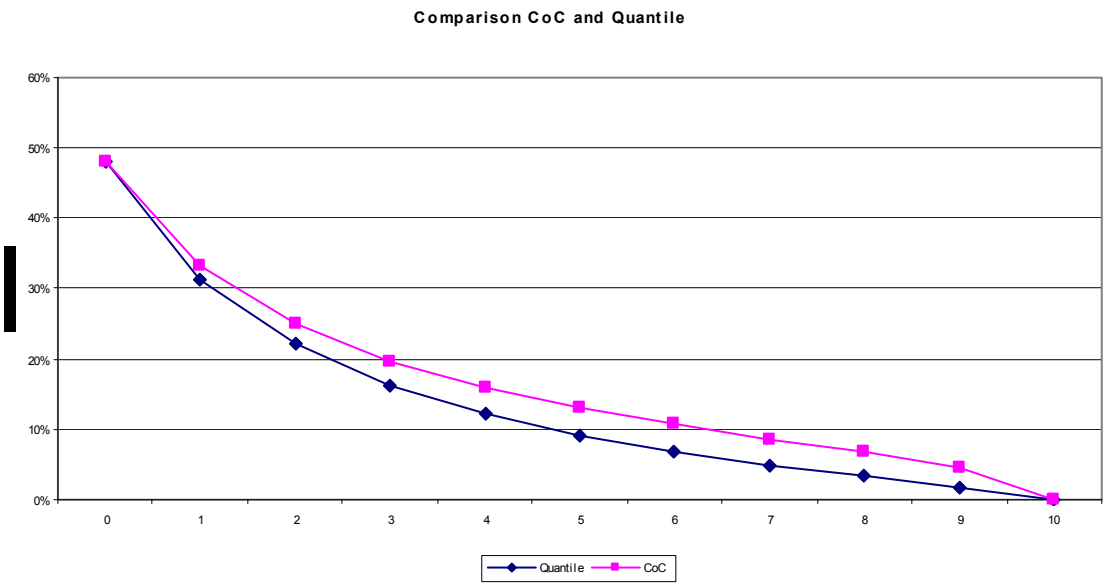
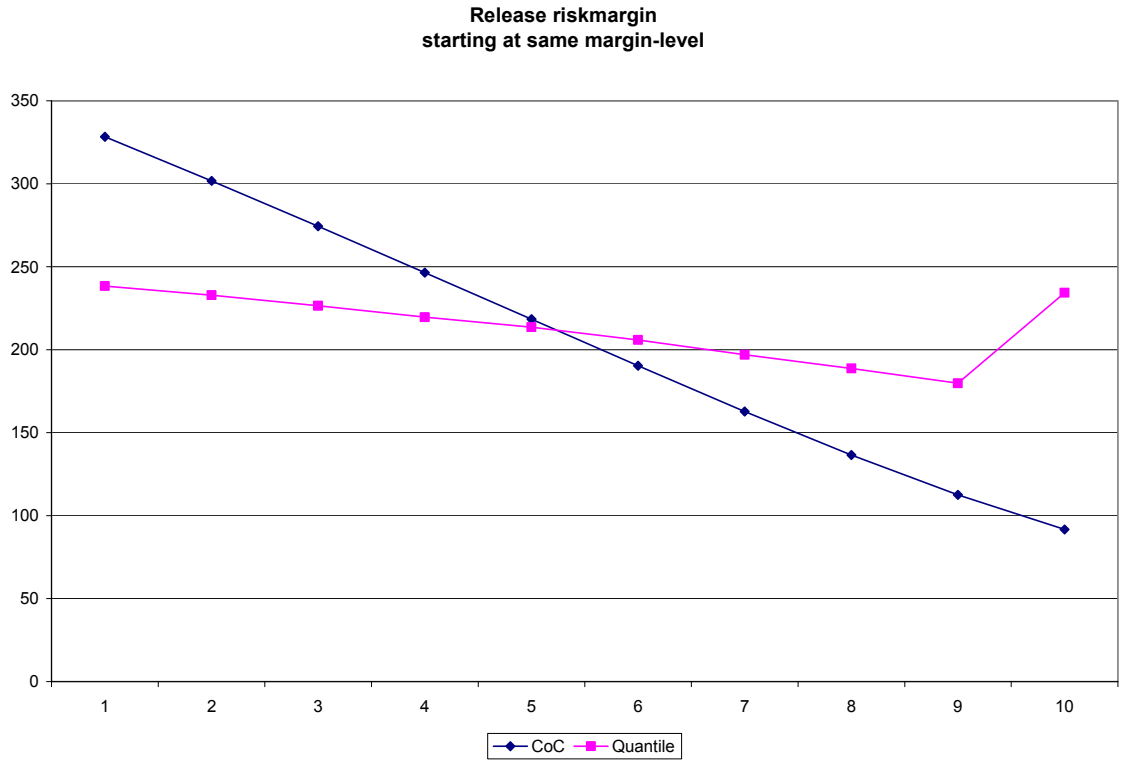


Table B.11 Risk margin release over time with consistent initial values – term life insurance



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

B4 Models used

B4.1 Current estimate

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

B4.2 Mortality trend uncertainty

Suppose the average age of the portfolio of contracts is 12 years and yearly mortality data from 1950 though 1998 is available. In creating the current estimate mortality rates, the current estimate trend is based on the average trend experienced between 1988 and 1995 (In 1988 there was a significant change in trend observed). Within the 48 years of observations 9 separate

trends are observed: so there is an average trend between 1950 and 1960 (i=1); 1955 and 1965 (i=2); etc.

Using the same method as was 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 can be calculated using the following formula:

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

(In case of positive risk it is advisable to limit a in the exponent to 10 years)

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

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

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

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

At the end of this appendix, a table is given with the necessary factors to calculate the economic capital with the student distribution.

B4.3 When insufficient volume of data is available

Sometimes insufficient data will be available to determine certain historic trends: for example, when new mortality tables are developed only once every 10 years. In these cases, a standard set of trend factors can be created. This standard set can be based on observations of groups of lives for whom data are available. The reason that this is possible is that we try to measure the possible changes of the trend observed in history. These changes should not differ very much between different categories of lives. Nevertheless, perhaps these standard sets might differ by region, continent or stage of development.

B4.4 Calculating economic capital using a student distribution

In Table B.12, the factors that can be used to estimate economic capital can be found depending on the degrees of freedom reflecting the number of trends available.

The factors then are multiplied by the 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 company) or 94% (12 year time horizon, equivalent with the yearly 99.5%), and for the quantile method at 90% and 75% confidence intervals.

Table B.12 Number of standard deviations needed in a student distribution

Degrees of freedom	EC (99.95%)	EC (98%)	Solvency 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

B4.5 Mortality level uncertainty

The following describes an approach that could be used to determine the portion of economic capital for the uncertainty determined with respect to the level of mortality.

A similar analytical approach to estimating the portion of economic capital needed to reflect volatility. This can be done because the level uncertainty is nothing more than the effect of the possible mistake in estimation. The reason for this possible “mistake” is the volatility in historical observations.

The method is based on the normal power (3) approximation (NP(3)). In this approach, the compound Poisson distribution is expressed in terms of a normal distribution using its first 3 moments. A complexity in using this method for the level uncertainty is that the risk capital can sometimes be determined only in the last year of the period. Assuming that the portfolio is rather stable over time in terms of average age, gender distribution and spread of the sum assured, a reasonable approximation of the NP(3) approach can be made. For relatively new portfolios we have to be careful. Further discussion regarding this situation is given later in this appendix.

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 claims over a certain period by the expected claims over the same period, based on the population mortality or an industry (reference) table:

$$f_{be} = \frac{\mu_{obs}}{\mu_{ref}}$$

In the level uncertainty we reproduce the uncertainty in the observations μ_{obs} by means of an adjustment factor: $f_{ec} = \frac{\mu_{obs} + (-)unc_{ci}}{\mu_{ref}}$

The uncertainty element in the numerator can be calculated using the same type of model as used in volatility.

$$unc_{ci} = \sigma(s_{ci} + t_{ci}\gamma)$$

The factors s and t depend on the time horizon and confidence level, as indicated in Table B.13:

Table B.13 s and t values

		Mortality	
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 should 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 this entire period. In that case, only the most recent dataset will be available for use. With a weighting factor h, a correction needs to be made:

$$h = \frac{\sum_j N_j}{N}$$

N = numbers of policies in the available dataset

$\sum_j N_j$ = total number of policies used over the entire observation period.

In this case, the formulas for 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 q_x's:

$$q_{ec}(x;t) = f_{EC} \times q_{POP}(x;t)$$

Then the economic capital can be expressed as:

$$EC = liab_{EC} - liab_{BE}$$

In the example this risk is set at a 10% decrease of q_x's. The reason for using this assumption is that we don't have real observations to determine the current estimate mortality for this portfolio. The 10% shock is based on experience gained by the application of the models described in this paper.

B5 Other items

Among other risks not explicitly dealt with in these examples include the following:

1. **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 it affects only risks for which increased mortality is an unfavorable factor..

3. **Expense risk** is estimated at 0.75% of the liabilities. This is a crude estimate and needs to be investigated further.

4. The same is true for **operational risk**, which has been set at 1% of liabilities, but will depend on country and entity and possibly product related factors. Further investigation is needed for these factors as well.

5. **Diversification risk** (See Section 7.4 for a discussion)

The economic capital components resulting from the use of the models are stand-alone levels of capital at a "sub-risk" level. Adding a portfolio to a well diversified AA rated company results in a smaller increase in the total economic capital of that entity than just adding together the components of capital otherwise determined. Each risk will have its own impact, depending on how well it diversifies into a large portfolio.

In this example, there is a portfolio of payout annuities. Such a portfolio will diversify more effectively in an entity with, on average, a positive risk (for example, through term insurance or endowments) and less effectively in an entity that has already a majority of negative mortality risks like annuities. The assumption made is that a "positive risk" entity takes over the portfolio.

The diversification factors are based on experience of a AA rated company with a positive risk profile on average. Diversification effects at a group level are allocated on a marginal basis. The results for the risks we have to deal with are given in Table B.14:

Table B.14 Diversification factors

Risk	*Diversification factor*
Trend uncertainty	0.25
Level uncertainty	0.25
Expense risk	0.50
Operational risk	0.75

For the quantile method, it is assumed that the underlying risks are independent (i.e., no tail correlation adjustment is needed at the 75% level).

For the cost of capital method, the cost of capital is set at a constant 4%. This level may be reasonable, but investigation needs to be conducted to confirm this. If the SCR (Solvency II capital, based on a rating of BBB, or 99.5% based on a one year time horizon) is used instead of the higher economic capital for a AA rated company, this percentage will be higher (for example, 6%).

APPENDIX C – Diversification

The objective of this appendix is to provide additional discussion on the topic of diversification. First, some general theory is provided. Then various technical approaches are discussed. It ends with a discussion of the concept of marginal diversification.

C1 Some general theory and thoughts

Diversification is critical to risk management. Diversification forms the foundation of insurance and is the key-stone on which important risk management processes rest. Diversification exits because of:

- Law of large numbers
- Opposite risks
- Unconnected risks
- Risks that are less than 100% interdependent.

The combining of risks that are not totally dependent causes the diversification effect: the total capital related to the combination of (sub-) risks will be equal or lower than the sum of the capitals for each sub-risk.

Part of the mentioned diversification effects, like the law of large numbers, will already be included in the models used to calculate the capital, e.g. the volatility over the modeled group of business. Also in case opposite risks exist within the modeled group of business this effect will be reflected in the modeling of the capital model. This latter is also called the netting effect. The diversification between the risk types and because of combining modeled blocks of business is done in the diversification model.

The diversification effect can be calculated at several levels:

a. Between sub-risks within a risk type
b. Between risk-types within a modeled block of business, for example business line or business unit.
c. Between business lines and/ or business units.

C2 Technical approaches

In the Blue Book IAA proposes the use of Copulas as the theoretically correct method to calculate diversification effects. Indeed in general we can say that the use of a “standard” correlation matrix is wrong. Copulas functions have the advantage that they can be used to accurately combine other distributions than from the “Normal Family”. They also recognize dependencies that change in the tail of the distributions.

Severe incidents can impact risks that are normally independent. Example: normally market risk and mortality risk will be independent. But in case of a severe Pandemic like the Spanish Flu would happen with worldwide millions of deaths this will certainly have economic consequences and will also impact market risk, for example equity risk. In practice combining several distributions implies that the dependency in the tail is higher than on average. In Copulas functions this can be defined, in a standard correlation matrix this is not possible.

Still, Copulas functions are rather complex to use, particularly in case a large number of distributions have to be combined. A practical solution can be to adjust the correlation matrix in such a way that a least at the confidence level we want to know the combined distribution the results are correct. The adjusted correlation factors are also called “Tail-correlations”. More background of this simplified approach can be found in the paper “diversification” by the Group Consultatif (www.gcactuaris.org).

C3 Marginal diversification

In the method described above the diversification can be calculated over a portfolio. In the quantile approach the diversification effects are calculated over the portfolio we want to know the 75% quantile around the liabilities.

In case we want to calculate an exit value, like in CoC we need to know the impact of the portfolio on the (economic) capital of the company that takes over the liabilities. Because of diversification effects within the transferred portfolio and between the transferred portfolio and the already existing portfolio, the increase of the capital will be less than the sum of the risks of the transferred portfolio and even less than the diversified capital of the transferred portfolio.
A simple example is included here to illustrate how this might work:

Suppose we have a portfolio with a capital of 1000. We want to add another portfolio with a capital of 100. Suppose this added portfolio is independent from the original one, so that the risks included in the 100 are independent of the risks in the 1000. This means that the total capital will be:

$\sqrt{1000^2 + 100^2} = 1005$.

Adding the new portfolio only increases the capital by 5 (=5% of the original 100). In case the two portfolios were not independent, but there was 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 (=30% of the original 100).

We need to determine these impacts for each of the risk types shown in Table B.1. The question is whether these factors should be combined into a more proportional rule. A problem is that some risk types diversify better than others. Therefore a compromise approach is chosen: the use of risk "Buckets." We split the risk types into groups with several levels of diversification.

Risk types with marginal diversification effects between 1% and 25% are allocated into the 25% bucket, between 25% and 50% in bucket 50%, etc. This process includes rounding in which some additional margin is created. In case the transferred portfolio creates more diversification for a certain entity, the Bucket system leads to some conservatism in the margins, and the other way around.

The reason for using the Bucket system is that it is difficult to define a unique, well diversified insurer. In the Bucket system, the diversification effects of most of the insurers will satisfied. In the Bucket system it is less important to define the reference entity.

Table C.1 Diversification credits

Level of diversification	Capital after diversification
Full	0%
High	25%
Medium	50%
Low	75%
No	100%

Based on experience and testing the types of risks shown in Table B.1 can be ordered according to the buckets shown in Table C.2 (note that this table includes life, health and property & casualty risks).

Table C.2 Ordering of risk types

Risk type	Life	P&C
Mortality level uncertainty	25%	--
trend uncertainty	25%	--
volatility	0%	--
calamity	50%	--
catastrophe credit risk reinsurance	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%
P&C current non-catastrophe uncertainty	--	25%
current non-catastrophe volatility	--	0%
current catastrophe risk	--	75%
catastrophe credit risk reinsurance	--	75%
claims development risk	--	25%
Morbidity uncertainty	25%	25%
volatility	0%	0%
claims development risk	0%	0%
calamity	50%	50%
Operational risk capital	75%	75%
Interest rate risk	--	--
Currency risk	--	--
Real estate risk	--	--
Equity risk	--	--

In the above table all volatility risks are set at 0 (full diversification). Alternatively they could also be assigned a relatively small, e.g., 25% value.

APPENDIX D – The IAA ad hoc Risk Margin Working Group Background

This appendix addresses the background of the IAA's ad hoc Risk Margin Working Group (RMWG), its Terms of Reference, and the process it has followed to develop this paper.

D1 Background

The International Actuarial Association (IAA) has, from its earliest days, endeavored to work cooperatively with both the International Accounting Standards Board (IASB – and its predecessor the International Accounting Standards Committee, IASC) and the International Association of Insurance Supervisors (IAIS).

When the IASC launched its project to develop a new international accounting standard for insurance contracts in late 1997, the IAA accepted the IASC's invitation to participate in the IASC Insurance Steering Committee and formed its own IAA Insurance Accounting Committee to liaise with the IASC. Later, the IAIS became involved in the IASC's insurance accounting project and launched its own project to establish Core Principles of insurance regulation and related regulatory guidance and standards. The IAA increased the remit of its Insurance Accounting Committee to cover both insurance accounting and insurance regulation issues.

It rapidly became apparent that the amount of activity in the accounting field and in the regulatory field was so large that the IAA would need two separate committees to deal with the two aspects of the rapid international developments in the insurance field. The IAA Insurance Committee was split into the IAA Insurance Accounting Committee and the IAA Insurance Regulation Committee. Bearing in mind the commonality of issues faced by the two IAA committees, the IAA developed a tradition of having a joint session in which the members of the IAA Insurance and Regulation Committees met as a "committee of the whole" during the committee meetings accompanying the biannual IAA Council meetings. One of its purposes was to ensure that each of the IAA committees that liaised with the other international organizations involved with insurance, the IASB and the IAIS, was aware of both the emerging issues facing and actions of the other relevant IAA committee.

By the time of the International Congress of Actuaries in Cancún in 2002, the IAA Insurance Accounting Committee was faced with the desirability of developing International Actuarial Standards of Practice (IASPs) for use in conjunction with what was to become IFRS 4, the first phase of the IASB's insurance contracts financial reporting standard. Shortly thereafter, the IAA

Insurance Accounting Committee formed its Actuarial Standards Subcommittee to deal with the development of these IASPs.

Similarly, the rapid evolution of the IAIS led to the establishment of several new subcommittees, including ones focused on insurance financial reporting and insurance solvency issues. The IAA reacted by establishing the IAA Solvency Subcommittee of its Insurance Regulation Committee to assist the IAIS in developing a possible new framework for international insurance regulation by the IAIS. In 2004 the IAA Insurer Solvency Assessment Working Party produced a comprehensive research report, “A Global Framework for Insurer Solvency Assessment," often called the *Blue Book*, which, in large part, helped to form the conceptual foundation underlying future IAIS solvency developments.

The adoption in March of 2004 by the IASB of IFRS 4, the first phase of its insurance contracts financial reporting standard, caused both the IAA and the IAIS to reinvigorate their respective efforts to interact with the IASB. The IAIS formed an Accounting Subcommittee to deal with overall insurance issues and an Insurance Contracts Subcommittee to deal with the specific issue of liability measurement for financial reporting purposes, while strengthening the mandate of the IAIS Solvency and Actuarial Issues Subcommittee (“Solvency Subcommittee") to develop the strong framework for regulating the solvency of the international insurance industry.

The practice developed that the IAA was represented at the IAIS Insurance Contracts Subcommittee by the co-vice-chairpersons of the IAA Insurance Accounting Committee. At the same time, the IAA was represented at the IAIS Solvency Subcommittee by the chairpersons of the IAA Insurance Regulation Committee and its Solvency Subcommittee.

In early 2005, the IAIS Insurance Contracts Subcommittee undertook to develop the IAIS’s First Liabilities Paper in which key issues were raised with the IASB concerning a possible measurement template from which the IASB could adopt standards for the measurement of liabilities for insurance contracts for general purpose reporting purposes that the IAIS could use as a basis for regulatory purposes. The co-vice-chairperson of the IAA Insurance Accounting Committee, acting as liaison to the IAIS Insurance Accounting Committee, was an active participant in the development of this IAIS paper, adopted in Beijing in late May 2005.

In developing this paper and its solvency regime, it quickly became apparent that the key issue, without which a common IASB / IAIS liabilities measurement template could not be developed, was what risk margins above current estimates should be included. In other words, in the development of an IAIS Solvency regime based on the “total balance sheet” (sometimes called “total financial resources”) concept as proposed in the

Blue Book, what part of the total financial resources objective should be included in liabilities?

This led the IAIS's Solvency Subcommittee to discuss how to proceed in its meeting in Tokyo held on May 30 to June 1, 2005, which in turn led to its draft of a Terms of Reference (ToR) describing how the IAA might assist the IAIS in the area of risk margins. The draft ToR were discussed at the joint meeting of the IAA's Insurance Accounting and Regulation Committees in Rome on June 15 2005, attended by key IAIS personnel, at which it was agreed that the IAA would form an ad hoc Risk Margin Working Group (RMWG) co-chaired by leaders of the IAA's actuarial standards and solvency subcommittees, Paul McCrossan and Henk van Broekhoven, with its membership initially drawn from the relevant IAA committees and subcommittees, while being open to other interested actuaries as well. The RMWG's final Terms of Reference is included in section F2.

The IAIS subcommittees met in Basel at the end of September 2005; followed immediately by the first face to face meeting of the IAA's RMWG to finalize its Terms of Reference and the process it would follow.

D2 Terms of Reference

In mid-2005, the RMWG began its deliberations to provide assistance to the IAIS in its development of approaches to establish a regulatory framework under which the liabilities for insurance contracts (*technical provisions* as often referred to in a regulatory context) should be measured. Included prominently was a request for assistance with a key element of these liabilities and provisions, the risk margins. The formal title of the IAIS request is "Approaches to the Determination of Liability Values and Quantitative Benchmarks for Technical Provisions." To carry out this request, the following Terms of Reference was adopted by the IAA's ad hoc Risk Margin Working Group (RMWG).

D2.1 Scope

"Issues related to the determination of best estimate policy obligations and technical provisions, and assessing the adequacy thereof, in the context of an insurer's total balance sheet."

D2.1.1 Note regarding terminology

At the time that the IAA received its reference from the IAIS, the IAIS used the term "best estimate," rather than "current estimate" as used in this paper. Subsequently, in 2006 in *Issues arising as a result of the IASB's Insurance Contracts Project – Phase II* (known as its Second Liabilities Paper), the IAIS adopted the terminology "current estimate" to refer to the

unbiased estimate of future cash flows reflecting the time value of money, defined as "the expected present value of probability weighted cash flows using current assumptions." Similarly, in the same paper the IAIS introduced the term “margin over current estimate (MOCE)” to refer to the margin reflecting the level of uncertainty in the calculation of the current estimate.

In this paper, the RMWG has adopted the use of the term “current estimate” and “margin over current estimate” as standard terminology, although the latter is frequently referred to as a "risk margin" or "margin" for brevity. "Current estimate" in some jurisdictions has been referred to as "central estimate" or "best estimate."

Note that, in other professional literature, the “current estimate” concept sometimes includes both concepts. In this paper, the liability for insurance contracts consists of the combination of the current estimate and the risk margin.

D2.2 Objective

“To provide detailed insight into current practice, challenges and solutions in relation to how actuaries determine best estimate policy obligations and technical provisions in a number of major insurance markets, approaches to determining their adequacy, the reliability and robustness of the different methods used and quantitative benchmarks to enable appropriate comparisons across insurers and jurisdictions.”

D2.3 Aim

“To assist the IAIS in defining

1. the role and purpose of best estimate policy obligations, risk margins and hence technical provisions in the context of both solvency assessment and public financial reporting, and the likely areas of difference between these two contexts;
2. principles and approaches that are appropriate for the determination of best estimate policy obligations, risk margins and hence technical provisions; and
3. measurable standards for assessing the sufficiency of best estimate policy obligations, risk margins and hence technical provisions in a manner that will allow supervisors *to:*

    a. readily assess the prudential risk margin above best estimate policy obligations that is included in the technical provisions of insurers and the reliability of an insurer’s history in making prudent assumptions in determining its risk margins;

    b. determine the differences in sufficiency of technical provisions between entities and enable comparison across jurisdictions; and

c. monitor the movement of prudential risk margins against changing market conditions, ensuring that, if pro-cyclical behavior exists, it can be arrested before insurers become vulnerable to failure."

D2.4 Supervisory reporting objectives

"As part of the common structure and common standards for the assessment of insurer solvency, to support transparency and convergence and enhance the comparability of insurers worldwide, … should support a supervisory reporting regime for technical provisions that will enable, for example:

1. reporting of technical reserves analyzed between best estimate policy obligation and prudential risk margin by line of business, covering life and non-life sub-sectors;
2. reporting of these components for a sufficient period (such as the previous five years) in order that triangulations in both components can be derived and thus assumptions validated; and
3. further analysis as appropriate by geographic location and, for reinsurance, by type of contract."

D2.5 Supervisory convergence problem addressed by the RMWG

"The terminology for and definition of best estimate policy obligations, risk margins and technical provisions, and the methods and approaches used to determine them, varies across and within jurisdictions. Further, there are different views regarding the reliability and robustness of the methods used and amounts determined using currently available approaches, techniques and data."

D2.6 IAA input requested

"In the context of insurer solvency assessment for supervision purposes, on:

- elements/risks that should be allowed for in the quantitative determination and valuation of best estimate policy obligations; technical provisions and risk margins;
- principles, methods and assumptions that are available for determining these values;
- specific issues or considerations related to any particular products or classes of business; and
- data and other requirements needed to enable the determination of reliable and robust values for supervision purposes."

D2.7 Relevant considerations

"The IAIS would anticipate that relevant considerations would include, but not be limited to:

- risks for which quantification/valuation is appropriate and reliable
- techniques, methods and models used and their calibration, reliability and robustness
- allowance for aggregation, correlation and risk interdependency
- detailed line of business discussion of issues and assumptions involved in determining and reporting both best estimate policy obligations and prudential risk margins (including reliability, volatility and availability of data).
- allowances for guarantees, bonuses and other embedded options
- effects of changes to reinsurance buying patterns (gross and net valuation and reporting).
- discount rates
- claim rates, amounts and settlement expenses
- materiality considerations."

D3 Process followed

Prior to the issuance of an exposure draft of this paper, the RMWG held five face-to-face meetings, in September 2005, and January, March, June and November 2006. It also had frequent exchanges of e-mails and conference calls between meetings.

In addition, selected (co- and vice-) chairpersons of the IAA's Insurance Accounting Committee, Regulation Committee and Solvency Subcommittee attended the meetings of the IAIS Insurance Contracts Liabilities and Solvency Subcommittees. Similarly, IAIS representatives attended RMWG meetings, as well as IAA's Insurance Accounting, Insurance Regulation and Solvency meetings during this period.

In part due to the lack of IAA paid actuarial staff, the RMWG decided at its first meeting that it would rely upon research that it was aware that:

- had been conducted by the IAA in the past and was capable of modification to help meet the IAIS objectives;
- was conducted or being conducted by its member organizations; or
- was conducted or being conducted by members of the RMWG.

The initial request from the IAIS was for a preliminary version by the end of 2005 and for a final paper by the middle of 2006. It was quickly determined that it would be impossible to produce a preliminary version of the paper by the end of 2005. Nevertheless, the IAA representatives to the IAIS Liabilities and Solvency Subcommittees were able to provide input to those subcommittees as they developed the IAIS's *Second Liabilities Paper*, the IAIS's *Roadmap Paper* and the IAIS's *Common Structure for the Assessment of Insurer Solvency* (*Common Structure*) Paper that reflected the developing RMWG research. Much of that input made its way into the work on these projects.

A three month period was provided for public comments. Twenty six written comments were received during or immediately after that period, copies of which are posted on the IAA website. Subsequently, a meeting of the RMWG was held in London on 13 June 2007 to discuss these comments and the way forward. This is the revised version resulting from those discussions.

The co-chairs of the RMWG have been Paul McCrossan and Henk van Broekhoven, although after a significant contribution, Paul retired from this service prior to the distribution of this Exposure Draft. Members include Tony Coleman, Philipp Keller, Arne Sandström, Masaaki Shigeraha, Therese Vaughan, and Peter Withey. Members Sam Gutterman and Francis Ruygt (in their capacity as chair and vice-chair of the IAA Insurance Accounting Committee, respectively) made considerable contributions, as did several other interested parties, including but not limited to Ralph Blanchard, Stefan Engeländer, Allan Kaufman, Martin White and Henry Siegel.

APPENDIX E – Current Estimate Assumptions

This appendix contains a discussion of selected specific assumptions (measurement inputs) to the calculation of current estimates of insurance liabilities (and reinsurance assets).

E2 Mortality rates

In this section, the setting of the mortality assumptions for use in the current estimate of death benefits is described. Expected mortality rates can be separately discussed in terms of: (1) its *level* that describes expected mortality during the last observation period and (2) its *trend* that describes the expected changes in mortality over the period of coverage, beginning with the period from which mortality was last observed, to develop current estimates of expected future mortality benefits. Most of this discussion also applies to survival rates.

E2.1 The level

E2.1.1 Insured mortality of the portfolio is not the same as population mortality. In general, the mortality of the insured population for life insurance is lower than that of the general population because of the effect of underwriting (selection) at issue. The difference depends on the period since underwriting, through so-called *select mortality*. The period of the select mortality depends on the extent of underwriting and age at time of underwriting. Experience has shown that it can last from 5 to 25 years, with a shorter period if no selection was performed or if voluntary termination rates are high. This period should be validated with mortality studies of the particular portfolio or similar insurance portfolios subject to the same underwriting standards, where relevant experience data is available. Mortality after this select period is referred to as *ultimate mortality*. If a portfolio of contracts experiences considerable voluntary terminations at or near a particular time (e.g., after a significant premium increase) or if no underwriting is conducted initially, anti-selection effects (unhealthy lives are less likely to terminate, giving rise to mortality higher than the ultimate level) may be experienced over time. Even if limited voluntary terminations occur or if not underwriting is conducted, mortality may differ depending on the insurer's target market.

E2.1.2 The mortality rates for most payout annuities will be lower than population mortality because healthier (than the general population) individuals usually choose to purchase payout annuities.

E2.1.3 In some countries, mortality tables for certain products, types of underwriting, markets, individuals or types of insurer have been developed for the insured population based on statistics from portfolio, entity, industry

insured or general populations. Differences in the market in which an entity operates, the intensity of underwriting and risk classification systems between portfolios and insurers can significantly affect expected mortality. In other cases where relevant insured experience is not available or is not of sufficient size, population tables have been used with adjustments developed from other sources to reflect expected or partially observed differences arising from the underwriting of the entity's target population. As an approximation, these adjustments have been expressed as an adjustment to age (e.g., insured mortality age y = population mortality x-5) or by an adjustment to the mortality rates themselves (q_x) by a multiplicative factor applied to the mortality rate of an individual age or an age group basis, often reducing by contract year. These adjustments may also vary by gender or other risk classification factor.

E2.1.4 Where relevant experience data is available, the estimation of the current mortality level applicable to the demographic and risk characteristics of a portfolio of insureds should be subject to statistical analysis, including:

- The mortality experience analyzed would ideally be based on the reporting entity's own portfolio of insureds with similar risk characteristics that were subject to similar underwriting approaches.
- The expected difference between the mortality of an insured population and the population from which the benchmark mortality experience was developed would be reflected, depending on such factors as age, gender, health, and smoking status, as applicable.
- The product type, type of sale and market involved: for example mortgage or pensions, term insurance, whole life or annuity.
- The issue year (select period).
- Underwriting procedures; for example, guaranteed issue, medical exam, or blood tested.
- Differences between the risk classification system in effect during the experience period and the business for which current estimates are being developed.
- Measurement based on sums (net amount) at risk rather than numbers of policies.
- Anti-selection effects caused by available termination options.

E2.1.5 Differentials in the mortality assumption (e.g., by risk class or product type) in the measurement of liabilities may not be necessary if not considered in underwriting or pricing, as long as the business is not subject to adverse selection as compared to the entity's competitors. That is, if premiums do not differentiate between a given risk characteristic of the insureds, the resulting experience of a given subcategory may not be the same as if they were individually selected. An example where it might not be reasonable to differentiate among population segments is if no insurer could legally differentiate their premiums between genders. In this case, it may be

reasonable not to use gender-specific mortality tables for financial reporting purposes either. However, if applicable experience relativities are available from the portfolio or other portfolios that use similar pricing differentials, the experience relativities would normally be used if they reflect the experience of the actual mix of insureds in the applicable portfolio.

E2.1.6 Reflection of the expected mortality experience of an individual insured is usually not useful, as measurement (unit of account) is usually portfolio-specific. It is common to use the expected mortality experience of the contract with respect to its risk classification category.

E2.1.7 Experience of similar groups of insureds is often the most relevant experience available that can be gathered. This may not be available in sufficient size to provide a fully reliable measurement base. To the extent that this experience is credible (that is, of a sufficient size and homogeneity), it should be used.

E2.1.8 In certain cases, statistical relationships between the experience of different insured groups cannot be precisely measured or can only be partly measured. If that is the case, less refined assumptions or sets of relativities may be justifiable, although if possible the reasonableness of such groupings or relativities should be validated in some manner, possibly through credibility techniques measured in terms of number of expected claims or volume of business. Important factors that can be considered include the mortality of the specific portfolio and the insured exposure (e.g., sum assured, face amount or net amount of risk), rather than number of policies or lives.

E2.1.9 If an estimation of mortality rates using age-dependent factors cannot be determined because the amount of experience in the estimation cells are too small (e.g., for a niche market), it may be possible for most ages to use age independent factors or theoretical mortality models (e.g., Gompertz or Makeham). In case of observed groups that are too small, products might be broadly grouped into positive risk (e.g., term insurance, universal life insurance, unit-linked life insurance, and whole life) and negative risk (e.g., pure endowment and payout annuities). In case no observations are available, (margin free) industry tables might be used with a constant percentage adjustment applied to all the mortality rates (for example +/- 20%, depending on an assessment of the relative effectiveness of the underwriting screening performed and the market penetrated). Although such an adjustment may be constant for several years, and some adjustment may be appropriate in the ultimate, as a percentage it would normally be expected to decline as the portfolio ages. The less accurate the data is, the higher the uncertainty, resulting in a higher risk margin assumption.

E2.2 The trend

E2.2.1 Because expected mortality rates change over time and can significantly affect current estimates, it is important to account for this expected change in setting assumptions for current estimates. For a long time, especially during the last century, life expectancies have increased (mortality rates have decreased). For most insured populations, life expectancies are expected to continue to increase in the future. An important issue is thus how fast the mortality rates will decrease and for how long.

E2.2.2 The historical decrease in mortality rates has been a result of positive and negative forces affecting the health and mortality of humans. The historical changes in mortality have been mainly caused by a combination of factors, sometimes positive (+) and sometimes negative (-), including:

- Medical and disease developments (+)
- Environmental effects (+ or -)
- Behavioral effects (+ or -)
- New diseases (-)
- For insured populations, changes in underwriting methodologies (+ or -).

E2.2.3 The effect of these trends can differ by population categories. For example, the net effect by age or gender may differ due to the relative effect of these factors, e.g., a new disease may significantly affect the very young but not affect at all those in their middle ages and changes in smoking habits can affect a cohort of insureds over a long period of time.

E2.2.4 Mortality rates for insured lives may also affected by improvement in underwriting methodologies (e.g., blood testing) or deterioration as a result of reduced underwriting screens necessitated because of the cost of the screens compared with their expected value.

E2.2.5 The rate of change in mortality rates was and is not expected to be constant. Several changes in trends have occurred, even in periods of generally increasing mortality rates, such as experienced in some countries for males at some age groups (45-75) between 1955 and 1975. This “hump” was caused by three negative drivers of change: increased frequency of heart disease, lung cancer due to smoking, and traffic accidents.

E2.2.6 The effect of these three drivers of change in the U.S. has been offset since the mid-1970s by medical developments and behavioral changes (e.g., the effect of significantly reduced rates of smoking by males, with effect of the smaller decrease by females expected to emerge shortly and enhanced treatment of blood pressure problems,). Other examples of increased mortality have included the effect of the AIDS epidemic in certain countries for certain ages and genders in the late twentieth century and the increase in alcohol use by Russian men in the late twentieth century.

E2.2.7 These and other potential factors can make it difficult, if not impossible, to reliably predict future mortality over a long period of time. Several methods to predict mortality have been in use, most based on an analysis of historical data over various time periods (e.g., through the application of the Lee-Carter method), sometimes supplemented by expert medical opinions.

E2.2.8 Very detailed models that have been constructed to estimate mortality trends can be classified in the following manner:

1. By cause of death. Problems with this approach include: the lack of knowledge of the effect of new causes of death or new treatments or medicines, a lack of sufficiently detailed and accurate historical data with possibly misleading historical trends, and the possible lack of correlation between historical and future patterns in these causes.

2. By structure. A mortality table can be partitioned into 3 or 4 age segments:
   - child mortality (decreasing by age);
   - aged portion (exponentially increasing);
   - large middle age segment with relatively constant accident causes (except for certain age groups such as young males); and
   - large middle age segment for sickness causes (gradually increasing by age).

   Effective implementation of this model requires a detailed experience data base.

3. General model. For all causes of death combined, historical experience trends are extrapolated into the future. Future changes in trends can be ignored.

4. Expert opinion. Experts provide their opinions regarding the level and period of future trends in the aggregate or by certain demographic segments or causes. A problem usually encountered using this method is that rarely do two experts arrive with the same conclusions regarding expected trends.

In practice, combinations of these four models are often used. For example, a calculation might be based on a general model, but validated with expert opinions, possibly with differential trends by large age segments. If properly controlled, such differences can be used to enhance the projection process.

E2.2.9 Just as is the case with other assumptions, the validation of their reasonableness is important. Do the future levels and relativities in tables look reasonable? A simple application of a statistical formula may not provide reasonable results. The results should 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.

E2.2.10 The expected level and changes in policyholder behavior, particularly policyholder persistency, can affect the mortality of a portfolio. This behavior can vary by such factors as premium or bonus/dividend patterns by duration or age, particularly compared to current product design available in the market, or changes in health.

E2.2.11 If sufficient portfolio experience is available, it is usually preferable to evaluate its historical trends rather than those of the aggregate population, as portfolio experience should be more relevant and more homogeneous over time. However, relevant portfolio experience is often not of sufficient size to permit this trend analysis. In addition, if changes in significant underwriting procedures or criteria have been applied over time, comparisons of general population may be more reliable. Observed and expected differences between these two types of experience sources can exist if portfolio-specific underwriting has selected out specific exposures (e.g., those with a history of cardiovascular disease) which are subject to different trends than other causes of death. In certain circumstances, such differentials can overwhelm or hide relevant underlying trends. Because the insured population may be subject to different influences than the aggregate population, caution is needed to use general trends without adjustment. It may be appropriate for both types of sources of information to be considered.

E2.2.12 The use of smooth tables based on Makeham or Gompertz models to estimate trends is usually not appropriate – these models spread special circumstances only applicable to a certain age group over a major segment or the entire table. Nevertheless, alternative approaches exist where the structure of the mortality table remains intact (see for example *NAAJ* vol. 6 no. 2).

E2.2.13 Depending on the volume of the experience base, it is often desirable to aggregate several years of experience to provide sufficiently credible experience. However, if too many years are used, there is a risk that the experience may be too out-of-date for use without adjustment. If the experience is out-of-date considering the expected trend in mortality during the period between the average period of the experience and current conditions, but is still relevant to the portfolio of risks, a trend factor should be applied to bring the experience to the conditions expected in the applicable future period.

E2.2.14 The time period over which a trend factor is to be applied needs to be determined. Differences of opinion exist regarding their application over

different periods, especially regarding whether an expected improvement trend should be decreased after a period of time, such as ten or twenty years. The results of an extrapolation of the same trend factor forever may result in an overstatement of the aggregate effect of the trend over the long term.

E2.2.15 Although most actuaries are comfortable in estimating and applying expected trend in the case of annuities, they feel uncomfortable in the case of applying such trends in life insurance. Although this may affect the risk margin applied, there is no conceptual reason why the expected trend factors would be different for these two types of coverages. If there is, it might be a sign of the use of such trends for prudence purposes.

E2.2.16 In some jurisdictions, there is an implicit assumption that premium rates will be reduced in response to improving mortality. An example is stepped premium products that provide policyholders an opportunity to cancel and re-enter at new business rates. It may be normal market practice in this case to reduce premiums from time to time to reflect improving mortality. The alternative would be to incorporate an offset to improving mortality from selective lapses if premium rates are not reduced.

E3 Property & casualty (general) insurance claim development

In this section, the estimation of future cash flows relating to property & casualty (general) insurance claims (and related expenses) for claims that have already been incurred is discussed. This liability includes estimates for reported and unreported claims. In general, these are assessed here in the context of a gross of ceded reinsurance basis of measurement, i.e., it does not reflect the effect of the specific measurement of or credit risk associated with ceded reinsurance assets. This section does not describe all of the many methodologies that have been developed. Rather, it describes some of the major considerations and approaches to the estimation of these cash flows.

In addition, it is common to use multiple methodologies in the process of developing estimates for these cash flows, sometime using estimates based on a blend of the methodologies.

E4 discusses estimates for unexpired risk liabilities for a stand-ready obligation, i.e., claims that have not occurred on contracts written or the estimation of potential reinsurance recoveries. Except for cases in which there exist evidence to the contrary, estimates of the stand-ready obligation use early experience (that is, relatively soon after claims are incurred) underlying the estimation of claim development.

Although the following primarily relates to the liability for property & casualty insurance claims, much of it also relates to claim liabilities for other insurance coverages, particularly for many forms of health insurance.

E3.1 Case liabilities, Incurred But Not Reported (IBNR) liabilities, and Incurred But Not Enough Reported (IBNER) liabilities

In the analysis of claim liabilities, expected claims may be separately categorized and separately assessed in the following manner:

- Case liabilities are those liability values assigned to individual claims that have been reported and recorded with an individual estimate at the valuation date, often set by claim adjustors, although for certain coverages, such as disability income, they are set by factors that are a function of the major characteristics of the claimants or claims. In some cases, these are assigned on an average basis depending on the type of claim involved, although this is usually applied when they are expected to be small or prior to insufficient information regarding the claims being obtained, without sufficient information to assess it on an individual basis.

- Incurred but not reported (IBNR) liabilities are for those claims that have not been reported to the insurer at the valuation date. In certain cases this includes cash flows associated with claims that may have been reported to the insurer but have not yet been recorded in the insurer's data base. In neither case has a case liability been assigned (pure IBNR). In some cases the IBNR refers to the sum of (1) a liability for incurred but not enough reported (IBNER), which the difference between the total expected cash flows for a cohort of claims, less those cash flows that have already been paid, and less any current claim liabilities, and (2) the pure IBNR. This combined liability is also sometimes referred to as the bulk or actuarial liability, in that the amount is not attributable to specific claims.

The claim liability is measured for a specified cohort of claims, often grouped by type of claim and such periods as the year of accident, loss or notice (referred to as the accident or loss year, depending on the coverage and situation). The liability is either estimated on the basis of total losses expressed in terms of currency units or in terms of losses separately evaluated by their expected claim frequency and size, depending on the coverage and data available (these methods are more fully discussed in E3.5).

E3.2 Loss adjustment expense (LAE)

E3.2.1 Expenses associated with the claim liability are usually analyzed in the same manner as losses, although sometimes independent techniques are applied. Although in most cases they are analyzed separately, there are exceptions if LAE is small in relation with the losses, in which case they are estimated on a combined basis. In part, this is due to the options available in managing claims. In some cases, an entity can incur additional expenses to avoid making or to reduce the amount of claims payable; in contrast, if the entity decides to pay all of the claims submitted, there will be little claim expense, but a larger amount of losses – this indicates that losses and a certain amount of their related expenses may be negatively correlated.

E3.2.2 Differences in the definition of LAE categories can be important in any comparison and analysis of trends in these expenses, as they can differ by accounting policy or jurisdiction. Potentially important are expenses associated with coverage disputes (between the policyholder and insurer) that can sometimes be significant but may be accounted for differently between accounting systems and allocation of overhead.

E3.2.3 A common method is to separately analyze the expenses that can be associated with individual claims (allocated, sometimes referred to as allocated loss adjustment expenses) and those that cannot (unallocated, often consisting of claims and legal management and staff and their related costs, sometimes referred to as unallocated loss adjustment expenses). Different methods are usually applied in the estimation of these two types of LAE. In addition to the type and mix of claims and the accuracy of expense allocations, the entity's claim management practice can also contribute to the relative amount of expected LAE in relation to losses, the relative amount of the two LAE or other types just referred to, as well as the speed of claim closing.

E3.2.4 Another aspect of the level of LAE may be due to relative efficiency of the entity's claim management process. Assuming that LAE is a non-market assumption, it would have to be measured on a portfolio-basis, reflecting the mix of claims and the business infrastructure used for managing the claim function, while if a market-based assumption, then some indication of what the market would charge for this function may be more relevant.

E3.2.5 Although in some areas, third party LAE fees charged might be observable (e.g., from third party administrators or outsourcers), recent historical LAE portfolio-specific development measured with respect to the portfolio or type of insurance coverage usually provides the most relevant and reliable experience from which to estimate future expenses. A review of third party claim administrator fees, although useful as a benchmark measure for this purpose, can provide misleading information, as they often vary widely by the specific claim portfolio's characteristics and volume of expected claims involved.

E3.2.6 Differences in the speed, claim management process and decision making can make a major difference in the overall claim and LAE costs. In addition, the interaction between claim management, LAE and claim severity is important in the analysis of claims, their losses and related LAE.

E3.2.7 Estimates of LAE should 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.

E3.3 Exposure to risk, frequency and severity

E3.3.1 Where available, analysis of experience is performed by exposure to risk, often measured by the premium charged or per contract, with the unit used varying by coverage.

E3.3.2 The frequency of claims is analyzed for coverages with relatively homogeneous claim exposure and claim count definitions, particularly for personal lines (e.g., protection against auto or home property claims), reflecting the ratio of the number of claims divided by the exposure to risk (although premium is sometimes used instead). There are several possible measures of number of claims that differ by coverage, e.g., the number of occurrences, the number of claimants, and the number of claims. This is not as often performed for other coverages, especially where contract exposures and claim counts are not homogeneous. A question could be raised as to whether a notification is or is not a claim, particularly under claims made and liability policies.

E3.3.3 Severity (average size of claims) is a metric that represents the size of the claims. The expected claim cost per exposure unit is equal to the product of the estimated claim frequency and the corresponding estimated average severity.

E3.3.4 The use of certain exposure metrics may be problematic. For example, the pricing exposure base for commercial automobile liability coverage sold to garages could be the amount of sales or the garage area in square meters/feet, while that for truckers could be the expected driving distance. In such cases, the resulting frequency and severity calculations for each component would not be easily combinable into a single meaningful frequency and severity measure for total commercial automobile liability.

E3.3.5 Loss and LAE payments. To discount expected claims, the expected loss and LAE payment patterns are needed. These are generally applied separately on a coverage-specific basis, reflecting the expected payment pattern measured from the end of the loss year. In many cases, historical

payment patterns can be determined for this purpose. In long-tail coverages, this can be more difficult, particularly for claims involving possible mass torts or new or slowly emerging types of claims, e.g., claims due to asbestos or lead paint liability.

E3.4 Relevant experience data

E3.4.1 In most cases, the analysis of claim development is primarily based on portfolio-specific data. Portfolio-specific data, rather than industry data is generally considered more relevant because it is based on the risk characteristics, coverage mix, and types and location of customers covered, as well as other characteristics such as claims handling.

E3.4.2 The measurement of obligations is typically determined separately by coverage or groupings of similar coverages with similar development characteristics and might be further segmented by type of claim, customer, policy, or size of claim, or geographic regions. Grouping of experience data used for measurement of claim development often differs from groupings used for pricing purposes and should reflect recent experience. Among other differences, pricing might reflect jurisdiction or rating territory within jurisdiction, as well as using portfolio-specific data for pricing limited ("basic") coverage, relying on broader groupings or even industry data to estimate the additional cost for the broader set of coverages. In contrast, liability measurement will often be based on a wider grouping of coverage, customers, markets and jurisdictions. As another example, many entities price using "basic limits," while relying on industry advisory factors where available for the additional cost of higher limits, or utilize models to estimate the additional charge necessary for higher limits.

E3.4.3 Nevertheless, there are many situations in which portfolio-specific experience data does not provide a relevant or reliable indicator of the ultimate loss experience of a cohort of claims. In those cases insurance industry data may be the only credible alternative if, for example, the portfolio is new, small, in the process of undergoing significant management changes or in which claims are expected to be of a low-frequency, high-severity nature. Also, for certain long-tail lines of business, few entities have sufficient historical experience to make coverage or portfolio-specific information reliable or cover the full expected claim settlement period; in this case the entity would usually use industry experience to supplement its own experience data. In many cases, industry data is viewed as a last resort. Entities are more likely to extrapolate the portfolio specific experience, perhaps based partly on industry experience for estimating the tail, even though the tail is very dependent on the portfolio and the claim handling particulars of the portfolio. Also, industry data is generally only available at a high aggregate level that is broader than many categories used to measure claim liabilities by the medium to larger entities.

The selection of the proper balance of portfolio and industry data and the categories for analysis of claim liabilities often requires professional judgment reflecting the facts and circumstances involved.

E3.5 Methodologies

E3.5.1 Experience data should 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.

E3.5.2 For many products, estimated claim liabilities can be based on such methods as paid and incurred chain ladder (also referred to as link ratio, triangulation, or development) methods, cost per claim closed, frequency-severity, Bornhuetter-Ferguson (where a prior expected claim levels based on a relevant exposure base is used for early period of the claim cohort), Cape Cod, Mack's method, and loss ratio-methods. Some of these only depend on historical claim development experience, while others also reflect estimated claims (using claim frequency and severity), policies, exposures, or premiums. Depending on the method, one or more variables may be used to estimate the expected claim development.

E3.5.3 Usually estimates of liabilities are based on more than one methodology – their results are assessed to determine which appear to produce more reliable and reasonable estimates. In some cases an average of two or more methodologies for the basis of the estimate, sometimes differing by claim cohort often separately by accident, report or underwriting year.

E3.5.4 Statistical modeling approaches can also be applied, albeit they are less common in many jurisdictions. Various refined methods, including those using stochastic simulation methods, are being increasingly used in certain circumstances, especially if confidence intervals or conditional tail expectations are desired as outputs from the methods applied (e.g., if used to measure risk margins).

The validity of these approaches, as with any approach, requires regular assessment, involving periodic validation. The objective is to use the method(s) considered to be the most reliable, given the experience available and appropriate expectations, rather than the blind adherence to the same approach(es) from period-to-period, although it is useful to document the reasons for any changes made.

E3.5.5 Selection of the liability methodologies applied is often based on professional judgment and may vary depending on the individual circumstances of the insurer, jurisdiction, coverage and accident year.

E3.5.6 Often a single “current estimate” scenario is developed, e.g., reflecting a single view of rates of inflation (including the influence of social, medical and general factors), current law affecting liability claims, and no mega-events of the type not already reflected in the experience data reviewed, e.g., no claims related to global warming or EMF radiation. It can exclude unusual data points, as long as the exclusion does not bias the resulting expected values and no change in claim handling compared with that of recent experience is expected.

E3.5.7 Insurance risks are often subject to skewed claim probability distributions, possibly both in terms of incidence more commonly severity, resulting in estimates resulting from a single "most likely" scenario often being less than the estimated mean value of all possible scenarios. For example, assuming a portfolio for which a frequency/severity approach incorporates an explicit inflation assumption would be appropriate if expected inflation might be either 4% with a 75% probability, or 2% or 8% (half or twice the expected value, respectively) with probabilities 12.5% each, so that a probability weighted average (estimated mean value) of scenarios might result in an effective inflation rate of 4.25%, rather than a most likely scenario estimate of 4%. Usually a one scenario approach is only justified if the effect of the use of the entire frequency, severity or total claim cost probability distribution is not expected to result in a significantly different estimate. Given the above, a test of the sensitivity of the estimate to different assumptions can provide useful insight, through the use of probability distributions or scenario analysis, and through the use of multiple estimation methods.

E3.5.8 Extreme events (e.g., the risk of liability claims due to mass torts, radical changes in law or judicial rulings, or large single events with significant uncertainties or uncertain law/judicial rulings, such as the one or two event uncertainty relative to the 2001 World Trade Center event) can potentially contribute significantly to the estimated expected value of losses of certain coverages and markets, particularly where key data elements are unavailable at the valuation date. In certain situations, disclosure of the uncertainty in financial reporting approach is preferable to the use of

insufficiently reliable estimates. Nevertheless, current estimates are usually made, even where they are subject to significant uncertainty, although the uncertainty should be appropriately be reflected in the risk margin and described in the insurer's disclosures. Note that applicable accounting standards or guidance might limit the use of such approaches.

E4 Stand ready obligation for property & casualty and other short-period contract periods

E4.1 In many jurisdictions, an unearned premium liability has been held for pre-claim liabilities. This liability is usually calculated on a pro-rata basis, depending on the time elapsed since the premium was paid (sometimes with a reduction for a pro-rata allocation of acquisition costs). If the exposure is non-linear over the contract period, the expected non-linearity can usually easily be reflected. This latter case can occur in situations with significant seasonal exposures, e.g., accident coverage of students while in school, automobile accidents during vacations/holidays or periods of high incidences of ice and snow, storm or warranty coverages by length of time since sale. In some jurisdictions, an unearned premium liability methodology may only be permissible if it can be demonstrated to be a sufficiently reliable approximation of the expected present value of risk-weighted future cash flows, considering both the uniformity of cash flows during the coverage period and that the period until settlement is similar for all claims.

E4.2 In other cases, the stand-ready (unexpired risk) obligation is determined as the current estimate of the expected value of the present value of risk-weighted future cash flows for future claims associated with the ultimate settlement of those claims. This reflects the current value of the unexpired risk for the remainder of the contract period, less any applicable expected premiums. Similar to a longer-term insurance contract, it is based on an expected value of the cash flows associated with the contract remainder, also reflecting present values and an adjustment for risk. In some cases, payment of future premiums for the remainder of the contract period may be enforceable in non-life insurance; such enforceable rights relieve any concerns regarding the recognition of the premiums. For most cases in which renewal premiums are not under control of the insurer, an initial asset would be recognized excluding those expected to be uncollectible, although no renewal premium would be recognized, depending on the accounting standard and guidance. In many jurisdictions (as required by IFRS 4), this current value is used in a Liability Adequacy Test (LAT) when the basis for the stand-ready liability is the unearned premium.

E4.3 Many of the same factors as given in Section 4 of this paper apply to the determination of the expected values used as a basis of this liability. Some differences may include:

- The expected cost of catastrophes for the unexpired risk period would be reflected for the remainder of the current contract period, while in most cases the emergence of a catastrophic claim is usually recognized at an early point in time as a cohort of claims are incurred.
- A liability adequacy test (LAT) would not be needed, as the calculations involved already inherently incorporate these expected values. However, a LAT would be required if current assumptions are not used.

E5 Expenses (other than loss adjustment expenses)

E5.1 Expense assumptions reflected in the expected value of future cash flows reflect future expenses associated with obligations arising from commitments the entity has made through the valuation date. These might, depending on the financial reporting standards and guidance, include some or all allocated overhead expenses.

E5.2 The extent 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 accounting policy is the contract, for example in as IAS 18 and 39. In contrast, some argue, as does paragraph 180 of the IASB Discussion Paper, the a contract could not be sold without considering full overhead expenses. if the portfolio is used as the unit of account, variable expenses (probably including allocated indirect expenses) would be used, e.g., as in U.S. GAAP SFAS 60. Other standards, including the tentative IASB's preliminary conclusions on phase 2 of its Insurance Contracts project, might only consider those expenses arising if the service provided could have been outsourced, reflecting a service profit margin with respect to the expected cash flows. Using the portfolio as a unit of account in those cases would permit some economies of scale to be reflected, but not overhead. If an entity-based measurement is used, e.g., as in many current regulatory reporting standards, all relevant overhead would be allocated and included in current estimates.

Paragraph 62 of the IASB's Discussion Paper indicates that in practice, although a market clearing expense level might be a more theoretically sound assumption, "the Board expectsthat an insure would use estimates of its own servicing costs, unless there is clear evidence that the insurer is significantly more or less efficient than other market participants. And even then, if the entity is more efficient than a market participant, it is unlikely that the purchaser or transferor would take steps to increase the entity's expense level.

E5.3 Since significant differences can exist in the development of expense assumptions in different accounting standards, it is important to understand the accounting basis for which those expense assumptions will be applied.

For example, the IASB in its Insurance Contracts Phase 2 project has not yet determined whether portfolio-specific, entity-specific or market-based measurement of expected future expenses is a more appropriate base. Even though portfolio-specific measures are apparently preferable, i.e., expense assumptions reflecting servicing needs of the portfolio measured rather than the service capacity of the entity, most insurance professionals favor entity-specific expense measures, as it is available, and is easier to measure and calibrate. In large part this is because it can be quite difficult to determine what applicable third-party costs would be for the product and service mix of a portfolio or entity and in most cases no reliable or relevant industry-wide inter-company or market-based expense benchmarks are available.

E5.4 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).

E5.5 An important element in the analysis of entity-specific or portfolio-specific expense experience data is the allocation of expenses. Important allocation categorizations include coverage or line of business, and between first year and renewal (or inforce) expenses, for which the latter is more relevant to long-duration contracts.

E5.6 The level of service and approach to servicing policyholders will usually affect both expense levels and voluntary contract termination and renewal rates. The cost of managing the entity's infrastructure can also be indicative of the entity's efficiency, although it can be argued that it is at least as indicative of the level of service expected in the price charged for a contract. For established entities, sufficient data is usually available for expense assumptions to be determined on a portfolio-specific basis. If practical, when developing a non-portfolio specific assumption, the entity's business strategy to achieve the desired level of service to policyholders (and its approach to claim management) can be taken into account. Its operational and service-level strategies indicate that whether an entity may be more or less efficient than other market participants, while the expense assumption normally reflects the general level of efficiency in the market.

E5.7 The use of a portfolio- or an entity-specific approach on an expected value basis implies that it is appropriate to reflect, or at least consider, management plans to improve the efficiency of its existing service level and

claim management strategy incorporated in the assumptions. Historically, allowance for the effect of projected improvements has usually been taken into account only when there is clear and objective evidence that it is appropriate to do so, that is, only to the extent that management has already developed specific plans and has a track record of being able to carry out such plans. In any case, the expense needed to execute such changes would be considered, as well as expected improved ultimate level of expenses. It is usually difficult to verify in advance that projects will achieve an improvement exceeding its cost, considering the large number of such projects that ultimately do not result in improved expense efficiency.

E5.8 All relevant administrative cost and applicable commissions would be estimated, although depending on the applicable financial reporting standard, only contractually-linked expenses are recognized in the measurement of the liabilities. Depending on the entity's accounting policy, if the unit of account is the portfolio or the entity, variable expenses or even general overhead expenses might be included. Where future deposits or premiums are incorporated into the measurement of insurance liabilities, expenses related to those deposits or premiums would also be taken into consideration. In addition, where appropriate the expenses of administering investments and related expenses could be taken into consideration in the determination of the discount rates.

E5.9 In developing assumptions regarding future cash flows, one-off expenses during the experience period would usually be eliminated. However, such expenses should be reviewed carefully, since many entities can incur similar in size but different in nature one-off expenses on a regular basis. In any event, small one-off expenses should not be adjusted for, as these types of expenses usually will reoccur, even though due to different circumstances. However, it would not be appropriate both to deduct the current investment in a new administrative system while at the same time to reflect the cost savings that are expected from the system’s implementation. Such adjustments from recent historical expense levels can go both ways; for example, a producer convention may not be held every year – in the year that one is not held, such expense may have to be added to that of the experience period.

E5.10 Subject to specific market conditions, expense assumptions for long-duration contract portfolios normally assume that the entity will maintain a reasonable level of new business and, therefore, the assumptions for the closed book, i.e., the book of policies in-force at the measurement date, would ordinarily be based on the current level of economies of scale.

E5.11 Even when the entity's accounting policy indicates that entity-specific expense assumptions are used, in situations such as a start-up or wind-down of an entity, or where the allocation of expenses is unusual, available

expense data may not serve as an appropriate basis for projecting future expenses. Normally in such a case it is appropriate to examine the experience data carefully so that the resulting assumptions provide for a reasonable level of future expenses consistent with the administration of contracts, investments, and claim settlement, and that satisfy the objective of the valuation. If a reliable steady-state expense data base is not available, alternative sources will have to be used or developed, e.g., industry studies if any, reinsurer advice (particularly for start-ups), third-party administrators specializing in run-off books of business in the case of a wind-up operation, or the entity's pricing assumptions.

E5.12 Future inflation-sensitive expense cash flows are usually assumed to vary with the assumed rates of general level of expense inflation in a reasonable manner. The starting point is normally the current level of inflation, with subsequent inflation assumed to reflect the expected relationship between inflation and future interest rates. A factor is then normally be added to reflect the issuer's level of unit expense trend relative to the market level of price inflation, when justified by the relative nature of the entity's business relative to that underlying observable market data, often consistent with assumptions of future interest rates. In some jurisdictions, technological efficiencies and market growth have more than offset general inflation in the trend in unit operating expense. However, if the unit metric used is based on the number of contracts, this net productivity improvement has been far more difficult to achieve. As different types of expenses are sensitive to inflation to differing extents (e.g., commission expense that is determined by formula in contrast with wage and benefit costs, which has often increased faster than general inflation), different rates of expense inflation may be associated with different types of expenses, although this applies only if discount rates are based on the entity's expectations.

E5.13 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.

E5.14 Relevant expenses of the entity's holding company or any related entity providing inter-group service would also be reflected, although if a measurement approach that relies on market prices is used, the equivalent cost available from the observable market place of the amounts charged by an independent third-party or transfer costs used for tax purposes might be appropriate. In the case of consolidated group financial statements, such inter-group charges will not have an effect, and the liability measurement will normally be based on the total actual expenses of the group, not necessarily what is charged.

E5.15 The expenses charged to the entity by a guarantee fund (whose purpose is to provide benefits to policyholders of entities who for financial reasons

cannot pay them) in a jurisdiction are a necessary cost to many insurers. This is usually based on an allocation of these costs allocated to the entity, often a function of prior business volumes of an entity. Although not a cost directly associated with the portfolio, it is generally felt that it is a cost of being in business and thus the expected charges, based on expected recent changes in volume of the entity, the cost of recent bankruptcies of other insurers, and expectations regarding future volumes and insurer bankruptcies would be reflected in the aggregate expense assumption.

E6 Policyholder behavior

Especially for certain long duration contracts, the effect of the election of policyholder options is important to reflect in the current estimate. If the measurement of the liability is unconstrained by the applicable financial reporting standard (i.e., some accounting systems do not permit certain policyholder behavior assumptions to be used at all), it would be appropriate to reflect the expected effect of the expected use of these options. See Section 5.1.6 of the paper for further discussion of consistency of assumptions. Special consideration should be given to apparently irrational policyholder behavior, since fundamental economic theory and models are based on the assumption of rational behavior.

Options available to the policyholder can include the termination of a contract (contract discontinuance rates, sometimes referred to as lapse or surrender rates) and use of non-forfeiture benefits where available, payment of scheduled or non-scheduled renewal premiums use of guaranteed insurability features, policy loan utilization, contract exchange, or other contractual options including guaranteed living benefits such as annuitization, guaranteed insurance options, partial withdrawals (partial contract discontinuance, either of a portion of the benefits or account values), and guaranteed income benefits. Their use can be particularly affected by other contract features and external conditions and insurer behavior, including being sensitive to interest rate levels or option costs such as surrender charges.

Some financial reporting standards require, for the purpose of estimating liabilities that rational financial behavior by policyholders that would result in the most disadvantageous effect for the insurer. However, it can be difficult in some cases to determine which the worst case is, considering the expected effect of anti-selection and moral hazard, particularly when current or future guaranteed insurability is involved. Examples of such situations include lapse-supported products (those in which the insurer can increase its expected profitability if greater voluntary terminations occur, such as long-term care contracts without cash values and with a very steep expected cost curve) or even 100% lapsation in certain cases, which may not be realistic and would be inconsistent with current estimates. The worst

case often would arise if all healthy policyholders terminate their contracts and all those with significant physical impairments remain. Realistic current expectations would incorporate at least some policyholder action or inaction that is not within their expected best interest (e.g., due to convenience, forgetfulness or loyalty to a producer). Alternatively, what might appear to be irrational behavior to external parties might be consistent with rational risk preference or personal conditions.

E6.1 Extent of rational behavior

E6.1.1 Based on observation, not all policyholders behave in what appears to be a rational financial manner. Unless constrained, expected assumptions can reflect that the extent of rational behavior is limited. For instance, even if insurance or investment guarantees are significant, certain policyholders will discontinue their contract in any event due to many reasons, including changes in their individual circumstances that the insurer will be unable to observe, or the existing policy will be exchanged for another that a producer of another entity presents to the policyholder. In contrast, other policyholders will continue to pay premiums whether or not they remain in need of the protection, in some cases as a result of having them automatically deducted from their checking account or from pure inertia.

In addition, because of fear of lack of current or future insurability or the focus on expected future contractual guarantees that might not currently be in-the-money, expected policyholder behavior, particularly on an individual basis, will be rarely lead to 100% termination. This behavior under a range of scenarios can be difficult to estimate.

The extent or quality of customer service level or perceived brand value, both entity-specific factors, can influence many policyholder behaviors.

E6.2 Discontinuance rates

E6.2.1 For most contracts, contract discontinuance assumptions are estimated, since the entity is exposed to risk from the potential use of the policyholder options to withdraw or persist, and if termination is decided upon to select the timing or the amount of such contract termination. Discontinuance can result from ceasing premium payments (this does not mean that the reporting entity's liability is necessarily eliminated at that time) or terminating the contract. Discontinuance can give rise to such action as the payment of surrender or transfer values, the exchange for a paid-up policy, or to a lapse without value.

E6.2.2 For most one-year contracts, a more common issue is the possible renewal of the existing contract. In most financial reporting standards, these renewals are only recognized when the accounting measurement

objective is fair values when current customer relations are considered. Even in this case, the primary attribute recognized would be non-level claim costs across renewal periods.

E6.2.3 The following are some considerations that can affect expected discontinuance assumptions. Most of these factors are portfolio-specific, although some are applicable on an entity-specific or type of product-specific basis, with many the result of contract features, policyholder characteristics, and overall conditions that affect the market or overall industry.

- Benefits and options provided through contract features;
- The way the contracts were sold and marketed (e.g., a universal life contract sold as low premium term insurance or primarily for investment purposes)
- Contract duration, attained age and gender;
- Premium frequency and payment method and mode;
- Premium paying status;
- Size of contract and current, expected future, and changes in the financial condition of the policy owner;
- Relative advantages of lapsation/withdrawal and persistency to the policyholder (e.g., due to insurability, current or anticipated tax and other benefit situation);
- Incentives, such as pattern of surrender charges (especially the end of a surrender charge or conversion period) and/or persistency bonuses;
- Sophistication and price-sensitivity of the policyholder and intermediary;
- Expected extent of competition for the product;
- Interest rate scenario and other economic factors (particularly for so-called “interest sensitive contracts”);
- Insurer behavior and decisions, e.g., timing and amount of bonus/dividend distribution compared to expectations and competition, service level provided, non-guaranteed elements credited or charged, interest rate credited compared to that available elsewhere;
- Distribution system, type of producer, and other marketing practices applied;
- Claim management practice, particularly for non-life coverages;
- Culture, such as the contrast between the very low annuitization rates in certain Western countries (e.g., the U.S.) and certain East Asian counties (e.g., Japan); and
- Expected changes in aggregations as a result of changes in the entity’s portfolio mix.

E6.2.4 If not guaranteed, the measurement of the surrender value payable on contract discontinuance, the following will usually be taken into account:

- Market and non-market assumptions applied in the projection;
- Any guaranteed surrender or transfer value scale; and
- Constructive or discretionary obligations provided for within the contract.

E6.2.5 Discontinuance experience normally has a significant effect on overall profitability to the issuer of many insurance and investment contract types, particularly its effect on expected future margins that exist to recover initial acquisition expenses and to compensate for the risk and service provided. To the extent practical, relevant and reliable discontinuance experience is used. In the absence of reliable experience data for the class of risk under consideration (e.g., new products or later durations in the policy), other comparable sources would normally be considered. These assumptions usually have to be portfolio-specific, reflecting other factors, including product and risk characteristics such as age.

E6.3 Other optionalities

E6.3.1 The cash flows of a contract can be affected by the use of policyholder options.

E6.3.2 Future premiums. The most commonly offered policyholder option is payment of future premium payments or deposits.

E6.3.2.1 These premiums or deposits may be regularly scheduled or their amount and timing can be flexible, e.g., for many universal life contracts. These latter include dumps or irregular premium paying patterns and partial withdrawals, which are separately estimated if the accounting standard provides for the effect of the expected pattern of use of these policyholder options.

E6.3.2.2 Other premium option features include automated premium increase acceptance where the policyholder has the right to not accept an automatic increase in an indexed policy or premium holidays in a pension contract.

E6.3.2.3 These are generally not under the control of the insurer, so may be considered by some financial reporting standards as intangible embedded assets. However, in most cases they are recognized in the measurement of future cash flows anyway, as they may be considered an integral part of the insurance contract.

E6.3.3 Other. Other examples of policyholder options that may or more not have associated costs to an insurer include:

- annuitization (often of deferred annuities, but also possible as a form of settlement of a life insurance death or maturity benefit);
- conversion of a term insurance contract for a permanent life insurance contract,

- allocation of account values among alternative asset funds,
- exchanges of one life insurance contract for another of a different or similar type, without or without evidence of good health,

E6.3.6 In many cases, the effect of the use of these options is asymmetric in nature. Although closed form solutions or other bases for developing estimates may be developed or possible to be developed, a set of representative or stochastically generated scenarios may be just as or more appropriate to use in the calculations involved in some cases.

E6.3.7 Depending on cash flow expectations, the effect of this behavior can be restricted by the form of contract. For example, depending on the financial reporting rules, renewal of one-year contracts may not be recognized, although the probabilities may be the same as if the contract were written in a perpetual form (with or without conditions). A different treatment may apply depending on the ability of the insurer to change premiums or when future premiums are not specified in the contract.

E6.3.8 The expected behavioral affect on utilization and cost of any deductibles, coinsurance or experience rating arrangements on claim experience of health insurance and some property & casualty insurance contracts.

E6.3.9 Other policyholder options may or may not have costs associated with them. These can include:

- Use of policy loans, including the right to take out or change the amount of the loan and the right to specific conditions of a loan;
- Add a new family member to an existing contract, either at a guaranteed or current rate;
- Change or add insureds, insured properties, beneficiaries or owners;
- Change the form of contract or feature of a contract, e.g., from a with-profit to a not-for-profit contract;
- Choose or change coverages and amounts in a group plan by an employee or participant;
- Reset conditions or terms of guarantees, e.g., segregated fund resets;
- Choose or change the form of dividend payouts, e.g., cash, paid up additions, term insurance, and accumulations;
- Change the Bonus Anticipation Rate;
- Choose a lump sum payment or an annuity form at retirement or other annuitization date;
- Choose annuity payout forms other than single life (systematic withdrawal, joint and survivor, fixed period, etc.) at retirement or other annuitization date, where the benefit is a fixed percentage of the benefit for a single life;
- Choose the timing of retirement or other annuitization date;

- Accelerate benefit payments in the event of a dread disease; and
- Utilize a free-look provision, e.g., right of return of a policy in the thirty days after a sale, or otherwise rescind a contract.

E7 Other assumptions

E7.1 Insurer behavior

E7.1.1 Insurer behavior can affect the delivery of certain contractual elements for which discretionary action or the method of delivery is allowed or inherent in the product or service provided. These can include policyholder dividends/bonuses, charges, fees or interest credits. For some products, the interest crediting process (the interest rate guarantees or the amount credited in excess of the guarantees) can become complicated, e.g., a deferred annuity contract may be assigned 24 or more interest rate crediting buckets corresponding to when the corresponding premiums (or deposits) were received, all associated with a different interest rate. In this case, deriving reasonable behavior estimates under each practical scenario can be quite complex. In addition, insurer behavior can affect the expenses allocated to provide insurance risk services, such as the method of handling claims.

E7.1.2 If this behavior is restricted, for example by law, regulation, constructive obligations, or contract a single set of behavior is assumed to be consistent with the applicable restrictions, although it might vary by scenario. Alternative behavior may also be reflected if appropriate (on either a deterministic basis, or if asymmetric risks/costs are involved, using stochastic or representative sets of behavior consistent with economic and demographic characteristics).

E7.1.3 Contractual constraints on insurer behavior include a wide variety of guarantees embedded in an insurance contract. These vary significantly by type of insurance, contract and jurisdictions. They can include such guarantees as:

- Contract continuance and renewal, based on guaranteed or market rates;
- Premium, charge and fee guarantees or maximums;
- Cash, non-forfeiture, capital (principal), and maturity values, either in terms of absolute amount or a value based on current conditions;
- Minimum benefits or credited or committed credited investment earnings;
- Annuity benefits, e.g., conversion rates, annuitization assumptions (e.g., mortality table), and death, withdrawal, living or income benefits;
- Guaranteed future insurability benefits, in the form of ability to purchase additional insurance or maintain currently determined benefits; and

- Immediate coverage after application signature.

E7.1.4 Changes in corporate strategies, whether in response to changes in conditions or management, should be reflected as they emerge or in certain cases as they are implemented successfully.

E7.1.5 Constraints to the recognition of the effect of this behavior is common, possibly as a result of contract features, legal requirements, or constructive obligations. Insurer behavior can also be prescribed based on its board resolutions or company policy.

E7.1.6 Insurer behavior can affect future insurer expenses, in terms of efficiency and effectiveness of operations of almost all of its functions, including those related to claim administration.

E7.1.7 Applicable financial reporting standards may require certain assumptions regarding expected behavior.

E7.1.8 Expected consequential policyholder behavior should be consistent with assumed insurer behavior. In addition, assumed insurer behavior should be consistent with the other assumptions selected.

E7.2 Reinsurance considerations

E7.2.1 In general, the counter-party to a reinsurance treaty is assumed to be knowledgeable about the contingencies involved. For example, it is usually assumed that the counter-party will exercise the terms of the agreement to its financial advantage, e.g., its ability to exercise contractual changes, usual and customary practices within the industry, and past practices of the parties involved. This can include recapture or commutation of a treaty, payment of a reinstatement premium to restore reinsurance protection, rating trigger of an action if a reinsurer's rating decreases to a certain level, change to the current scale of reinsurance premiums or expense allowances that may be dependent on the scenario of cash flows, and recapture options.

E7.2.2 Counter-party credit (non-performance) risk. The payment history, credit rating, risk-based capital ratios or other available relevant information about a reinsurer are taken into account in determining the probabilities of expected reinsurance recoveries that affect the measurement of the reinsurance asset. The extent that these factors are considered in the insurance liability or reinsurance asset will depend on the accounting standard for reflecting this risk.

E7.3 Other assumptions

Other assumption not described in this paper include morbidity and recovery rates for contracts involving health insurance, rates and amounts of salvage and subrogation, longevity rates for pure endowments, annuitization and conversion rates.

GLOSSARY

- **Assumption**. An input parameter used in an estimation model to measure actuarial items, such as liabilities for insurance contracts or economic capital for an insurer.

- **Asymmetry**. The extent to which a probability distribution deviates from a symmetric form (with equally weighted sides around the mean.

- **Best estimate** (also see *current estimate*). Usually refers to as a best available estimate of an expected or mean value (i.e., probability-weighted average of all possible outcomes), which is the interpretation taken in this paper. In some circumstances can refer to the most likely outcome or include a risk margin as in IAS 37.

- **Blue Book** (see *A Global Framework for Insurer Solvency Assessment)*

- **Calamity risk** (also referred to as *catastrophe risk*). The risk associated with an extreme loss event or series of outcomes. Associated with the extreme right tail of a probability distribution.

- **Capital**. The amount of resources available in excess of the entity's liabilities, sometimes referred to as the net assets of the entity. *Economic capital* is the capital needed by the insurer to satisfy its risk tolerance and business plans which is determined from an economic assessment of the insurer's risks, the relationship between them and the risk mitigation in place. [IAIS, *Guidance Paper on Enterprise Risk Management*, Draft 1 July 2007, footnote 15, page 12] *Regulatory required capital* is the minimum amount of capital an insurance entity needs in order to remain in business without a regulator requiring an adverse action, such as taking control of the entity.

- **Conditional tail expectation** (*CTE*, also referred to as *Tail Value at Risk* (*TailVaR*)). The conditional expected value of that part of a probability distribution that lies above a given quantile.

- **Cost of capital**. The opportunity cost associated with a given amount of capital.

- **Cost of capital method**. An approach used to estimate risk margins that is determined based on the cost of holding the capital needed to perform the obligation.

- **Credibility**. In actuarial literature, it is the extent that a given set of information can be used or relied upon for the purpose of estimation. In its application,

information from a first source of information is given a certain weight, while external or other information is given its complementary weight (one minus the first weight).

- **Current entry value**. The amount a policyholder would have to pay to an insurer at a point in time if the policyholder would acquire a new contract of a similar nature for its remaining lifetime at that point in time. It is a result of the application of a customer consideration model.

- **Current estimate**. The unbiased estimate of future cash flows, considering all currently available information, that reflects the time value of money.

- **Discontinuance rate** (also referred to as *surrender rate*, *lapse rate*, or *policy termination rate*). The probability of a policyholder terminating a contract, usually on a voluntary basis. The conversion of the contract through a non-forfeiture option is usually included in this probability.

- **Economic value** (see *capital*)

- **Exit value**. The amount an insurer would expect to pay or receive at the current date if it transferred its outstanding rights and obligations under a contract to another entity.

- **Explicit assumption method**. An approach used to estimate risk margins included in the measurement of a liability in which margins are estimated for each major assumption under risk explicitly.

- **Extreme event risk** (also referred to as *catastrophe risk*). The risk of occurrence of outcomes with unusually high severity, usually with a very low probability of occurring.

- **Fair value**. The amount for which an asset could be exchanged or a liability settled, between knowledgeable, willing parties in an arm's length transaction. [IAS 32.11]

- **Financial risk**. The risk that the market assessment of the value (its price, including applicable time value of money) of an item changes, without reflecting a change in the item itself: "The risk of a possible future change in one or more of a specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating or credit index or other variable, provided in the case of a non-financial variable that the variable is not specific to the party to the contract." [IFRS 4, Appendix A]

- **General insurance** (also referred to as *property & casualty insurance* or *non-life insurance*). Insurance covering property and liability risks. Sometimes includes health insurance risks.

- ***A Global Framework for Insurer Solvency Assessment*** (also referred to as the *Blue Book*). Written in 2004 by the Insurer Solvency Assessment Working Group of the IAA.

- **Guarantee**. An obligation that is not subject to an option of the obliged and does not specifically depend on the performance of the obliged.

- **IFRS 4**. International Financial Reporting Standard Number 4, "Insurance Contracts".

- **Insurance**. Accounting: A contract feature under which one party (the insurer) accepts significant risk from another party (the policyholder) by agreeing to compensate the policyholder if a specified uncertain future event (the insured event) adversely affects the policyholder. [IFRS 4, Appendix A]. The legal definition of insurance is subject to local law and regulation, but in all cases relates to the provision of insurance coverage.

- **IAA**. International Actuarial Association.

- **IASB**. International Accounting Standards Board.

- **IAIS**. International Association of Insurance Supervisors.

- **Liability** (the liability for an obligation for an insurance contract in some regulatory contexts is referred as a *technical provision* or *actuarial reserve)*. The amount recognized in the balance sheet of an entity that represents the net effect of the net obligations under an insurance contract. Accounting: "A present obligation of the enterprise arising from past events, the settlement of which is expected to result in an outflow from the enterprise of resources embodying economic benefits." [IAS 37, Definitions]

- **Life insurance**. Insurance risk associated with the death or survival of an insured. It often is used to include annuities, and in some contexts also includes some forms of health insurance.

- **Loss adjustment expense** (for life and health insurance sometimes referred to as *claim settlement expense*). Expense of an insurer associated with the management or defense of its obligation with regard to claims made under an insurance contract.

- **Margin over current estimate** (*MOCE*, see *risk margin*). The risk margin that reflects the level of risk and uncertainty in the determination of the current estimate.

- **Market factor**. A specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating, credit index or other variable, provided that in the case of a non-financial variable the variable is not specific to a party to the contract. [taken from, but not defined in IFRS 4, Appendix A, in the definition of *financial risk*]

- **Measurement input** (also referred to as *assumption*).

- **Non-market assumption**. An assumption that refers to items other than price available from a market, such as mortality rates in the case of life insurance contracts.

- **Normal distribution**. A probability distribution which is symmetric around its mean whose density takes the form of a bell-shaped curve with a single peak.

- **Obligation**. The duty associated with a contractual promise or arising from regulatory requirements. Accounting: "A duty or responsibility to act or perform in a certain way. Obligations may be legally enforceable as a consequence of a binding contract or statutory requirement. Obligations also arise, however, from normal business practice, custom and a desire to maintain good business relations or act in an equitable manner." [IASB Framework, 60]

- **Offsetting risks.** A risk mitigation technique that uses the negative correlation of the uncertainty associated with a second set of obligations or rights to reduce the risk for a first set of obligations or rights.

- **Operational risk**. A risk of loss resulting from inadequate or failed internal processes, people or systems, or from external events affecting the operations of the entity directly, rather than directly related to contractual related risks.

- **Option**. A right under a contract to unilaterally select one of a defined set of rights or obligations subsequently available under the contract.

- **Parameter risk**. The risk of an estimation error in an underlying parameter in the measurement of a financial item.

- **Percentile method** (see *quantile method*)

- **Policyholder behavior**. Selection by a policyholder of an available option within a contract.

- **Policyholder bonus** (also referred to as *bonus* or *policyholder dividend*). The amount paid to a policyholder by an insurer relating to a participating (insurance or investment) contract in excess of what is contractually guaranteed.

- **Pooling**. A risk mitigation technique involving the grouping of insurance contracts with similar insurance risk exposures.

- **Portfolio**. A group of similar items managed in combination.

- **Probability density function** (*PDF*). The shape of the probability curve of a mathematical function of a continuous random variable. It is the first derivative of the *probability distribution function* (sometimes referred to as the *cumulative distribution function*] is the probability that a value is greater than a certain number.

- **Process risk** (also referred to as *deviation risk*). The risk of statistical fluctuation of an uncertain value due to a lack of size of what is being measured. It can be measured before or after risk mitigation techniques are applied.

- **Quantile method** (also referred to as the *Percentile method*). An approach used to estimate risk margins that expresses uncertainty in terms of the excess of a percentile (quantile) for a given confidence level above the expected value for a given period, such as the lifetime of the coverage.

- **Reference entity**. A large, well diversified and financially secure entity that is used to identify a hypothetical entity to determine certain assumptions in a measurement approach. In certain applications, the entity is assumed to be fully diversified.

- **Regulatory capital** (see *capital*)

- **Reinsurance**. An insurance contract issued by one insurer (the reinsurer) to compensate another insurer if an insured event occurs. [IFRS 4, Appendix A]

- **Replication**. A method by which reliable prices can be assigned through equivalent means, such as through observation of market prices for one or more transactions that are equivalent to the value desired.

- **Risk**. The variability in outcomes in a process that is fully understood, e.g., the result of rolling a pair of fair dice. [IAA Blue Book]

- **Risk concentration**. The extent to which an entity is overly exposed to a particular risk or type of risk.

- **Risk diversification**. A risk mitigation technique involving diversifying the portfolio. A risk is diversifiable if it is of sufficient size and type for which there

are sufficient uncorrelated but dissimilar risks available to reduce the fluctuations caused by the risk or type of risk in a diversified portfolio.

- **Risk margin**. The amount of a measurement of a liability associated with the risk and uncertainty associated with insurance risk. An amount or *margin* reflecting an assessment of the uncertainty inherent in an insurance risk with certain attributes based on a specific measurement approach.

- **Risk Margin Working Group** (*RMWG*). The Task Force of the IAA, initiated in 2005, to respond to a request of the IAIS.

- **Risk mitigation technique**. A management approach that reduces a risk born by the entity.

- **Service margin**. A margin included in the measurement of a liability for services not involving insurance risk, if market participants would be expected to require such a price for accepting the risks associated with providing the service.

- **Skewness**. The extent to which a probability distribution deviates from that of a distribution which is symmetric in nature.

- **Stand ready obligation** (also referred to as an *unexpired risk liability*). The obligation to be prepared to deliver resources, e.g., a product or service in response to an event outside the control of the obliged.

- **Swap rate**. An interest rate swap contract is an agreement between two counterparties to exchange fixed interest-rate payments for floating interest rate payments, based on a pre-determined notional principal, at the start of each of a number of successive periods.

- **Swiss Solvency Test** (*SST*). Statutory test of the adequacy of the capital held by a Swiss insurer.

- **Tail of the liability**. The portion of the probability density function of the expected cost of the remaining contract risk exposure in excess of a specified high confidence level.

- **TailVar** (see *Conditional tail expectation*)

- **Technical provision** (see *liability*). An amount set aside on the balance sheet to meet liabilities arising out of insurance contracts, including claims provision (whether reported or not), provision for unearned premiums, provision for unexpired risks, life assurance provision and other liabilities related to life insurance contracts (e.g. premium deposits, savings accumulated over the term of with-profit policies). [IAIS, Glossary]

- **Total balance sheet** (also referred to as *total financial resource requirements*). The sum of the technical provisions and required capital of an entity resulting from a specified regulatory measurement approach.

- **Uncertainty**. The additional variability in outcomes that occurs because the process is not fully understand, the model used might be incorrect to some degree and/or the actual model parameters will vary from the estimated parameters. [IAA Blue Book]

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