Project **Insurance Contracts**

Topic **Risk adjustment**

Purpose of this paper

1. This memorandum provides an overview of an approach that measures an insurance contract using a risk adjustment (plus a residual margin). The balance of this memorandum uses excerpts from memorandums used at the March and April joint Board meetings as well as feedback received from the boards during those meetings to describe a risk adjustment. The staff also provides suggested language for an approach that limits the range of permitted techniques by specifying the available risk techniques.

2. The memorandum should be read in conjunction with Agenda Paper 2A (FASB Memorandum No. 45A). In that memorandum, the staff asks the boards to make a decision about which approach (risk adjustment [plus a residual margin] or composite margin) is the preferred approach. In addition, if the boards select an approach that uses a risk adjustment, the staff will ask, as a follow-up question, whether the exposure draft should limit the range of permitted techniques.

3. Consequently, there are no questions for the boards or staff recommendations in this memorandum.

Background

4. At the March meeting:

    (a) The IASB decided tentatively that:

        (i) The measurement of an insurance contract should include a separate risk adjustment.

(ii) The risk adjustment should be the amount the insurer would rationally pay to be relieved of the risk [the objective proposed for the risk adjustment used in the IASB's recent Exposure Draft, *Measurement of Liabilities in IAS 37*].

5. At the joint meeting in March, the boards also discussed how the insurer should subsequently release the residual margin to profit or loss (at inception the residual margin equals the difference between (a) the expected premiums [IASB: expected premiums less incremental acquisition costs] and (b) the expected claims and expenses plus a risk adjustment). The boards tentatively decided that the insurer should release the residual margin over the coverage period in a systematic way that best reflects the exposure from providing insurance coverage, as follows:

   (a) on the basis of passage of time; but

   (b) if the insurer expects to incur benefits and pay claims in a pattern that differs significantly from passage of time, the residual margin should be released on the basis of the expected benefits and claims at inception.

6. At the joint meeting in April, the boards discussed certain aspects of the residual margin. The boards tentatively decided that:

   (a) The residual margin should be part of the insurance liability rather than a separate liability outside the insurance liability and should be disclosed separately.

   (b) With regard to accreting interest on the residual margin, the boards were split. The IASB decided tentatively that interest should be accreted and the FASB decided tentatively that interest should not be accreted.

Risk adjustment

Characteristics of the risk adjustment

7. The following is draft language that was included in the staff recommendation in Agenda Paper 3A (FASB Memorandum No. 43A) (paragraph 17) discussed at the April 2010 joint meeting (partly modified):

> **The amount the insurer would rationally pay to be relieved of the risk taking into consideration that the amount of benefits and claim costs actually paid may exceed the amount expected to be paid.**
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> A risk adjustment measures the amount, if any, that the entity would rationally pay to be relieved of this risk.
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> The objective of including a risk adjustment in the measurement of an insurance contract is to convey useful information to users about the uncertainty associated with the contract. To achieve that objective the estimate of the risk adjustment should consider the effects of uncertainty about the amount and timing of future cash flows. Because an insurer often would not be able to identify observable market information about risk adjustments, the entity would have to estimate the amount it would rationally pay to be relieved of this risk.
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> To convey useful information about the amount the insurer would rationally pay to be relieved of risk, the characteristics of that risk adjustment shall, to the extent practicable, include the following:
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> (a) The less that is known about the current estimate and its trend, the higher the risk adjustment should be.
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> (b) Risks with low frequency and high severity will have higher risk adjustments than risks with high frequency and low severity.
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> (c) For similar risks, long duration contracts will have higher risk adjustments than those of shorter duration.
>
> (d) Risks with a wide probability distribution will have higher risk adjustments than those risks with a narrower distribution.
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> Furthermore, an insurer should select an approach for determining risk adjustments that considers the following factors:
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> (a) Numerous techniques exist for determining the risk adjustment. The selection of the appropriate technique may vary between types of insurance contracts and different entities. Judgment must be applied in determining the appropriate technique for each type of insurance contract. Various techniques are available and the use of the techniques may vary by product. For example, one potential technique could focus on a particular confidence level achieved through the use of a quantile technique. Another technique is based on cost of capital, acknowledging that an insurer's ability to sell new business to policyholders depends on holding sufficient capital to enable it to cope with adverse events. The application guidance provides information about the potential techniques

available and the considerations that should be take into account with regard to those techniques.

(b) Risk adjustments should be explicit, not implicit. That is an important change from many existing practices that rely on estimates incorporating an implicit (and often unstated) degree of conservatism or prudence. Separating explicit estimates of future cash flows from explicit risk adjustments would improve the quality of estimates and enhance transparency.

(c) The risk adjustment for an insurance liability should reflect all risks associated with the liability.

(d) The risk adjustment for an insurance liability should not reflect risks that do not arise from the liability, such as investment risk (except when investment risk affects the amount of payouts to policyholders), asset-liability mismatch risk, or general operational risk relating to future transactions.

(e) The approach should not ignore the tail risk in contracts with very skewed pay-offs, such as contracts that contain embedded options (eg the interest guarantees and other financial guarantees embedded in many life insurance products) or that cover low-frequency high-severity risks (such as earthquake), or portfolios that contain significant concentrations of risk. For example, if a large portfolio of insurance contracts is subject to significant earthquake risk but the insurer estimates that the probability of an earthquake is only 1 per cent, the approach should not ignore that risk.[1] Option-pricing methods or stochastic modelling may be needed to provide effective estimates of the risk adjustments associated with these items.

(f) The approach should make it easy to provide concise and informative disclosure, and for users to benchmark the insurer's performance against the performance of other insurers.

(g) If more than one approach is compatible with the above criteria, it is preferable to select an approach that builds on models that insurers use (or are developing) to run their business.

(h) The approach should not overlook model risk (the risk that a model is not a good description of the underlying process) or parameter risk (the risk that a model uses estimates of parameters that differ from the true parameters, or that the parameters may change over time).

Caution is needed in making judgments under conditions of uncertainty, so that liabilities are not understated. However, uncertainty does not justify deliberate overstatement of liabilities. Care is needed to avoid duplicating adjustments for risk with consequent overstatement of the liability.

Although the risk adjustment is included in the measurement as conceptually separate from the other building blocks (expected cash flows, discount rate),

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[1] The tail risk affects both (1) the expected cash flows and (2) the risk adjustment required for possible variations from the expected cash flows. Estimates of expected cash flows need to capture the effect that tail risk has on (1). The risk adjustment needs to capture the effect of tail risk on (2).

this is not intended to preclude 'replicating portfolio' approaches. A replicating portfolio is a portfolio of assets whose cash flows **exactly** match those contractual cash flows in amount, timing and uncertainty. If a replicating asset exists for all (or, more likely, some) of the cash flows, the insurer can include the fair value of these assets in the measurement of the insurance contract, instead of estimating the expected present value of those cash flows and determining an explicit risk adjustment for those cash flows. To avoid double counting, the risk adjustment does not include any risk that is captured in the replicating portfolio.

Application Guidance for the risk adjustment

8. At the April 2010 meeting, several Board members stated that paragraphs 21 through 32 in Agenda Paper 3A (FASB Memorandum No. 43A) provided useful guidance in identifying which risk adjustment techniques would be useful. Given the limited amount of time, the staff has provided some drafting here but would anticipate a more robust analysis in the exposure draft.

APPLICATION GUIDANCE

Considerations used in selecting a risk adjustment technique

The following implementation guidance provides some insight into the necessary consideration when choosing the appropriate risk adjustment technique. In some instances, a particular technique is more appropriate than in other instances. The facts and circumstances of each situation should be considered when selecting a methodology.

The following list of risk adjustment techniques is not intended to be exhaustive but rather to highlight the more common techniques and the desirable attributes of such techniques when attempting to satisfy the objective of a risk adjustment. Accordingly, if a risk adjustment technique is not discussed in this application guidance, it could still be a viable technique for achieving the object of a risk adjustment. The classes of risk adjustment techniques are:

(a) Explicit assumption (for example, factor-based or judgment based on experience studies)

(b) Cost of capital

(c) Quantile (for example, Value at Risk or Conditional Tail Expectation)

(d) Discount rate (for example, risk adjusted returns)

(e) Sensitivity/stress test

(f) Stochastic modeling

(g) Calibrate to capital markets or insurance pricing

Explicit assumption techniques

These techniques can be best described as being based on the actual assumptions (unbiased estimates used in determining the expected present value of the cash

flows). That is, the risk adjustment is the function of a percentage or limitation (for example, a minimum or maximum amount) of the assumption. One example is specifying a particular mortality table and then adjusting the mortality table by 5% to reflect the risk. The adjustment might need to vary by line of business; the riskier lines of business would have a higher percentage.

Explicit assumption techniques simply increase or decrease an assumption by a fixed percentage and are not responsive to changing risk conditions. It is therefore unlikely that explicit assumption techniques meet the objective of a risk adjustment as described in this standard.

Cost of capital techniques

Cost of capital techniques attempt to reflect in the risk adjustment the cost of bearing risk. That is, the estimated cost of holding the capital that is needed to give policyholders comfort that valid claims will be paid, and to comply with regulatory capital requirements, if any.

Insurance is a capital intensive business and an insurer is cognizant of off-loading risk to free capital for redeployment (especially when pricing is favourable). Accordingly, an insurer would be able to determine the amount of capital necessary to support a portfolio or line of business over time. However, in estimating the amount that it would rationally pay, an insurer would probably need to refer to economic capital rather than regulatory capital because regulatory capital can be distorted by specific regulatory requirements that may not be considered *rational* in the context of general-purpose reporting (that is, the regulators main concern is solvency as opposed to profitability).

Quantile techniques

Quantile techniques use statistical approaches to derive the risk adjustment. These techniques can be further divided into the following:

(a) Confidence intervals

(b) Conditional Tail Expectation

(c) Multiples of the second or higher moments of the risk distribution

Confidence intervals

A *confidence level* provides the likelihood that the estimate will be included within the interval. The confidence level is sometimes referred to as Value at Risk (VaR). The IAA's paper *Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins* provides a clear description of the use of confidence intervals in determining a risk adjustment stating:

> Risk margin methods based on confidence levels express uncertainty in terms of the extra amount that must be added to the expected value so that the probability that the actual outcome will be less than the amount of the liability (including the risk margin) over the selected time period equals the target level of confidence.

The use of *confidence intervals* for determining a risk adjustment has the benefit of being easy to communicate to users. However, the usefulness of confidence intervals diminishes when the distribution of losses is not normal (that is, the loss distribution is skewed which is often the case for insurance contracts). When the loss distribution is not normal (that is, the mean and median are not equal), the

selection of the confidence interval must take into account additional factors such as the skewness of the loss distribution. In addition, this technique ignores outliers (extreme losses in the tail) in the loss distribution.

For example, suppose a confidence level of 95% is used and the following estimates are made for two contracts. For contract A, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 1,010. For contract B, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 2,000. At the 95% confidence level, these two contracts will have the same risk margin. On the other hand, at say the 97% confidence level, contract A will be measured at CU1,004 and contract B will be measured at CU1,400.

Conditional Tail Expectation

Conditional Tail Expectation (CTE) (also referred to a Tail Conditional Expectation and Tail value at risk) is an enhancement of value at risk. CTE provides a better reflection of the potentially extreme losses than value at risk by incorporating the expected value of those extreme losses in the measure of the risk adjustment. The Society of Actuaries' paper *Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products* provides the following description:

> The CTE method is a modified percentile approach that combines the percentile and mean values of different cases. It basically calculates the mean of losses within a certain band (or tail) of pre-defined percentiles. With the CTE method, the margin is calculated as the probability weighted average of all scenarios in the chosen tail of the distribution less the mean estimate (which may or may not be the median, i.e. the 50^{th} percentile). The CTE method is an improvement over the percentile (VaR) method discussed above since it smoothes some extreme claims (or statistical outliers).
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> The key advantage of the CTE is that since it applies fundamentally the same calculation technique as the mean estimate, it has the benefit of consistency and it also reflects the skew of the distribution in the risk margin. For example, the CTE over the 75% confidence level (often referred to as CTE(75)) of a claim distribution is the expected value of all claims that fall into in the highest 25% of the claim distribution. The margin in this case would be taken as CTE (75) less the mean (i.e. best estimate) of claims.

For example, consider the above example. For contract A, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 1,010. The CTE(95) for contract A is CU 1,005. For contract B, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 2,000. The CTE(95) for contract B is CU 1,500.

The focus of a CTE technique on the tail reflects a fundamental aspect of insurance—the fact that the riskiest part of an insurance contract is the tail. As part of the analysis of the amount an insurer would rationally pay, a significant amount of consideration would be given to the tail of the risk (that is, the loss distribution). Consequently, CTE techniques would meet the objective for a risk adjustment described in this paper. However, a confidence interval (such as value at risk) approach still may meet the objective if distributions are not particularly skewed.

Multiples of the second or higher moments of the risk distribution

The term *moment* is used in mathematics to describe different features of the shape and size of a distribution. The first moment is the mean of the probability distribution (in this project, that would be the first building block—the unbiased probability-weighted cash flows). The second moment is the variance of the cash flows. The variance (and its square root, the standard deviation) represents the width of the distribution. The wider the distribution, the higher the uncertainty (and the larger the variance or standard deviation).

The first and second moments are sufficient to describe completely the shape and size of a normal distribution (a bell-shaped curve). However, as noted previously, the loss distribution for insurance contracts is generally skewed and for those distributions, additional ("higher") moments are needed to describe the distribution.

The third and fourth moments are the skewness of the probability distribution and the kurtosis of the probability distribution, respectively. Skewness captures the lopsidedness of the distribution and kurtosis reflects the relative size ("fatness") of the tail of the probability distribution.

A risk adjustment based on multiples of the second or higher moments of the risk distribution can be used to achieve a selected confidence level. For example, the Society of Actuaries' paper *Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products* provides the following example:

> …a company could calculate the sample variance or the 3rd moments of sample mortality (or death benefits relative to death exposures). They could then add a percentage of variances to the mean assumption to derive the mortality parameter where the percentage multiplier is determined to target a certain level of confidence. For example, the mortality assumption could be set equal to the sample mean plus 0.1 times the sample variance. Similarly, if a risk parameter is known to be normally distributed, setting the assumption to equal the sample mean plus 0.675 times the sample standard deviation would result in risk margins calibrated to approximately the 75th percentile.

This technique suffers from similar drawbacks as previously noted for this family of techniques—specifically, it may be difficult to estimate the moments, especially when the loss distribution is skewed and there is significant judgment in determining what multiple to use .

Discount rate techniques

Discount rate techniques use adjustments to the discount rates to reflect the risk adjustment. In the case of a liability, the discount rate would be lowered, increasing the measurement of the liability. The lowering of the discount rate implicitly creates the risk adjustment. An insurer generally does not consider adjustments to discount rates when determining the amount that an insurer would rationally pay. A technique based on adjustments to discount rates is more appropriate for financial instruments where markets exist and can be observed. Generally no secondary market exists for insurance contracts and prices in the primary market may not be readily observable. A discount rate technique may provide a reasonable indication of the pattern of release from risk if risk is directly proportional to the amount of the liability and the remaining time to maturity. However, insurance liabilities do

not always have these characteristics. Consequently, a risk adjustment based on a discount rate is unlikely to meet the objective of the risk adjustment.

Stress/Sensitivity testing

This technique is comprised of stressing the underlying assumptions and determining how the changes in the assumptions impact the expected claim payments or capital. In determining the amount an insurer would rationally pay, the stress/sensitivity testing would be used as a means for supporting or testing a given risk adjustment but not as a sole technique used to achieve the stated objective. That is, stress/sensitivity testing would generally not meet the objective of the risk adjustment. However, those techniques could enhance or test another technique that does meet the objective.

Stochastic modelling

Stochastic modelling is a technique used to estimate probability distributions of potential outcomes by randomly varying one or more inputs over time. Generally historical information is used to derive the randomness of the outcomes and a large amount of simulations using the random variances is run.

The objective for a risk adjustment would allow for the use of stochastic modelling where that modelling is appropriate for determining pricing. For example, for contracts that involve complex guarantees and portfolios exposed to catastrophic risk, stochastic modelling techniques may be used in pricing these products in both the primary insurance and reinsurance markets. Accordingly, an insurer might use stochastic modelling to determine the amount it would rationally pay to be relieved of the risk for these hard-to-price contracts. However, a stochastic modelling technique may not be cost-beneficial in some instances because of the increase in complexity as more variables are included and the difficulty of controlling and auditing such a technique.

Calibrate to the capital markets or insurance pricing

Calibrating to the capital markets or insurance (or reinsurance) pricing uses market information to derive a risk adjustment. In many instances, market participants are including in the pricing of risk the same uncertainty that a risk adjustment is attempting to include in the measurement of the insurance contract such as volatility of the cash flows and expectations of future cash flows. In the proposed insurance model, market inputs (such as interest rates and equity prices) are required to the extent that they exist for an insurance contract. However, in most instances an observable market does not exist for many of the inputs to an insurance contract. As discussed above, reinsurance pricing could be used as an input for meeting the objective of a risk adjustment, but it probably would be applied together with other evidence. A calibration technique appears to be better suited to benchmarking or testing other techniques for determining a risk adjustment. However, should observable markets for insurance contracts develop over time, this technique may be appropriate.

Alternative approach for risk adjustment

9. During the April meeting, some Board members advocated an approach to the objective for a risk adjustment whereby the objective narrows the acceptable

techniques that could be used to determine a risk adjustment. The staff provides the following alternative language for consideration by the boards:

APPLICATION GUIDANCE

The amount the insurer would rationally pay to be relieved of the risk taking into consideration that the amount of benefits and claim costs actually paid may exceed the amount expected to be paid.

An entity shall consider the risk that the actual cash flows might ultimately differ from those expected. A risk adjustment measures the amount, if any, that the entity would rationally pay to be relieved of this risk. The level of confidence is intended to convey to users the degree of uncertainty surrounding the measurement.

The objective of including a risk adjustment in the measurement of an insurance contract is to convey useful information to users about the uncertainty associated with the contract. To achieve that objective the estimate of the risk adjustment should consider the effects of uncertainty about the amount and timing of future cash flows. Because an insurer often would not be able to identify observable market information about risk adjustments, the entity would have to estimate the amount it would rationally pay to be relieved of this risk.

To achieve the stated objective, a confidence level technique (or Value at Risk) will be sufficient to meet the characteristics of the risk adjustment for some contracts. For example, if the distribution is not significantly skewed or if time is not a significant factor for the risk.

In other cases, for example if the distribution is more skewed or if time is a significant factor for the risk, other techniques may better reflect the characteristics of a risk adjustment to such an extent that their application outweighs the simplicity of a confidence level technique. In that case, the insurer should apply either a Conditional Tail Expectation technique (or Tail Value at Risk) or a Cost of Capital technique. The insurer should use judgment in determining whether it uses the confidence level technique or one of those other two techniques to meet the characteristics of the risk adjustment. The insurer should be able to justify why the Conditional Tail Expectation and the Cost of Capital techniques are more relevant than a confidence level technique.

[**The following two paragraphs would be included in the disclosure section but have been included to assist with understanding the alternative approach to a risk adjustment.**

The insurer should disclose the confidence level at which it determined its risk adjustment. If the insurer uses a Conditional Tail Expectation approach or a Cost of Capital approach, it discloses the confidence level to which the risk adjustment determined under those methods corresponds (for example, that the risk adjustment of CUX determined at Conditional Tail Expectation (Y) corresponds to a confidence level of Z%).

Under any technique, disclosure of the technical (actuarial and statistical) and (if any) management's rationale underlying the specific technique selected.]

To convey useful information about the amount the insurer would rationally pay to be relieved of risk, the characteristics of that risk adjustment shall, to the extent practicable, include the following:

(a) The less that is known about the current estimate and its trend, the higher the risk adjustment should be.

(b) Risks with low frequency and high severity will have higher risk adjustments than risks with high frequency and low severity.

(c) For similar risks, long duration contracts will have higher risk adjustments than those of shorter duration.

(d) Risks with a wide probability distribution will have higher risk adjustments than those risks with a narrower distribution.

Furthermore, an insurer should select an approach for determining risk adjustments that considers the following factors:

(a) The selection of the appropriate technique may vary between types of insurance contracts and different entities. Judgment must be applied in determining the appropriate technique for each type of insurance contract. The application guidance provides information about the techniques available and the considerations that should be take into account with regard to those techniques.

(b) Risk adjustments should be explicit, not implicit. That is an important change from many existing practices that rely on estimates incorporating an implicit (and often unstated) degree of conservatism or prudence. Separating explicit estimates of future cash flows from explicit risk adjustments would improve the quality of estimates and enhance transparency.

(c) The risk adjustment for an insurance liability should reflect all risks associated with the liability.

(d) The risk adjustment for an insurance liability should not reflect risks that do not arise from the liability, such as investment risk (except when investment risk affects the amount of payouts to policyholders), asset-liability mismatch risk, or general operational risk relating to future transactions.

(e) The technique should be implementable at a reasonable cost and in a reasonable time, and be auditable.

(f) The technique should not ignore the tail risk in contracts with very skewed pay-offs, such as contracts that contain embedded options (eg the interest guarantees and other financial guarantees embedded in many life insurance products) or that cover low-frequency high-severity risks (such as earthquake), or portfolios that contain significant concentrations of risk. For example, if a large portfolio of insurance contracts is subject to

significant earthquake risk but the insurer estimates that the probability of an earthquake is only 1 per cent, the approach should not ignore that risk.[2]

(g) The technique should make it easy to provide concise and informative disclosure, and for users to benchmark the insurer's performance against the performance of other insurers.

(h) The technique should not overlook model risk (the risk that a model is not a good description of the underlying process) or parameter risk (the risk that a model uses estimates of parameters that differ from the true parameters, or that the parameters may change over time).

Caution is needed in making judgments under conditions of uncertainty, so that liabilities are not understated. However, uncertainty does not justify deliberate overstatement of liabilities. Care is needed to avoid duplicating adjustments for risk with consequent overstatement of the liability.

Although the risk adjustment is included in the measurement as conceptually separate from the other building blocks (expected cash flows, discount rate), this is not intended to preclude 'replicating portfolio' approaches. A replicating portfolio is a portfolio of assets whose cash flows **exactly** match those contractual cash flows in amount, timing and uncertainty. If a replicating asset exists for all (or, more likely, some) of the cash flows, the insurer can include the fair value of these assets in the measurement of the insurance contract, instead of estimating the expected present value of those cash flows and determining an explicit risk adjustment for those cash flows. To avoid double counting, the risk adjustment does not include any risk that is captured in the replicating portfolio.

APPLICATION GUIDANCE

Considerations used in selecting a risk adjustment technique

The following implementation guidance provides some insight into the necessary considerations when choosing the appropriate risk adjustment technique. In some instances, a particular risk adjustment technique is more appropriate than in other instances. The facts and circumstances of each situation should be considered.

The following techniques for determining a risk adjustment are provided to highlight the desirable attributes of such techniques when attempting to satisfy the objective of a risk adjustment. These techniques are as follows:

(a) Confidence intervals

(b) Conditional Tail Expectation

(c) Cost of capital

Confidence intervals

Rather than using a single amount (such as a mean), a *confidence interval* uses an interval that will likely include the desired outcome to provide an indication of the

[2] The tail risk affects both (1) the expected cash flows and (2) the risk adjustment required for possible variations from the expected cash flows. Estimates of expected cash flows need to capture the effect that tail risk has on (1). The risk adjustment needs to capture the effect of tail risk on (2).

reliability of an estimate. A *confidence level* provides the likelihood that the estimate will be included within the interval. The confidence level is sometimes referred to as Value at Risk (VaR). The IAA's paper *Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins* provides a clear description of the use of confidence intervals in determining a risk adjustment stating:

Risk margin methods based on confidence levels express uncertainty in terms of the extra amount that must be added to the expected value so that the probability that the actual outcome will be less than the amount of the liability (including the risk margin) over the selected time period equals the target level of confidence.

The use of *confidence intervals* for determining a risk adjustment has the benefits of being easy to communicate to users and of being relatively easy to calculate. However, the usefulness of confidence intervals diminishes when the distribution of losses is not normal (that is, the loss distribution is skewed which is often the case for insurance contracts). When the loss distribution is not normal (that is, the mean and median are not equal), the selection of the confidence interval must take into account additional factors such as the skewness of the loss distribution. In addition, this technique ignores outliers (extreme losses in the tail) in the loss distribution.

For example, suppose a confidence level of 95% is used and the following estimates are made for two contracts. For contract A, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 1,010. For contract B, the 95% confidence level is CU1,000 and the remaining 5% of the distribution is evenly spread from CU1,001 to 2,000. At the 95% confidence level, these two contracts will have the same risk margin. On the other hand, at say the 97% confidence level, contract A will be measured at CU1,004 and contract B will be measured at CU1,400.

Conditional Tail Expectation

Conditional Tail Expectation (CTE) (also referred to a Tail Conditional Expectation and Tail value at risk) is an enhancement of value at risk. CTE provides a better reflection of the potentially extreme losses than value at risk by incorporating the expected value of those extreme losses in the measure of the risk adjustment. The Society of Actuaries' paper *Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products* provides the following description:

> The CTE method is a modified percentile approach that combines the percentile and mean values of different cases. It basically calculates the mean of losses within a certain band (or tail) of pre-defined percentiles. With the CTE method, the margin is calculated as the probability weighted average of all scenarios in the chosen tail of the distribution less the mean estimate (which may or may not be the median, i.e. the 50^{th} percentile). The CTE method is an improvement over the percentile (VaR) method discussed above since it smoothes some extreme claims (or statistical outliers).

The key advantage of the CTE is that since it applies fundamentally the same calculation technique as the mean estimate, it has the benefit of consistency and it also reflects the skew of the distribution in the risk margin. For example, the CTE over the 75% confidence level (often referred to as CTE(75)) of a claim distribution is the expected value of all claims that fall into in the highest 25% of the claim

distribution. The margin in this case would be taken as CTE (75) less the mean (i.e. best estimate) of claims.

The focus of a CTE technique on the tail reflects a fundamental aspect of insurance—the fact that the riskiest part of an insurance contract is the tail. As part of the analysis of the amount an insurer would rationally pay, a significant amount of consideration would be given to the tail of the risk (that is, the loss distribution). Consequently, CTE techniques would meet the objective for a risk adjustment described in this paper. However, a confidence interval (such as value at risk) approach still may meet the objective if distributions are not particularly skewed.

Cost of capital techniques

Cost of capital techniques attempt to reflect in the risk adjustment the cost of bearing risk. That is, the estimated cost of holding the capital that is needed to give policyholders comfort that valid claims will be paid, and to comply with regulatory capital requirements, if any.

Insurance is a capital intensive business and an insurer is cognizant of off-loading risk to free capital for redeployment (especially when pricing is favourable). Accordingly, an insurer would be able to determine the amount of capital necessary to support a portfolio or line of business over time. However, in estimating the amount that it would rationally pay, an insurer would probably need to refer to economic capital rather than regulatory capital because regulatory capital can be distorted by specific regulatory requirements that may not be considered *rational* in the context of general-purpose reporting (that is, the regulators main concern is solvency as opposed to profitability).