Financial accounting module 21: Risk adjustment for non-financial risk

(The attached PDF file has better formatting.)

The final exam problems say whether the risk adjustment for non-financial risk accretes interest; they do ***not*** ask you to compute the risk adjustment for non-financial risk by either of the two methods in this posting. The sections on the confidence level method and the cost of capital method show the logic of the risk adjustment for non-financial risk, but the final exam does not test the calculations. You must know how the risk adjustment for non-financial risk affects the fulfilment cash flows, the contractual service margin, and insurance revenue. You are not responsible for the end-notes in this posting (which cite the text of IFRS 17).

RISK ADJUSTMENTS: FINANCIAL RISK VS NON-FINANCIAL RISK

The fulfilment cash flows are a risk-adjusted present value of the future cash flows that include an explicit risk adjustment for non-financial risk.[1] IFRS 17 distinguishes between risk adjustments for financial risk and risk adjustments for non-financial risk.

- The risk adjustment for financial risk is based on market variables, such as the currency of the future cash flows, the term structure of interest rates, and the liquidity of the insurance cash flows. It should not differ among insurers (unless their claim cash flows have different liquidity), though insurers may use different methods to quantify the risk adjustment for financial risk and may derive different estimates.[2]
- The risk adjustment for non-financial risk compensates insurer for bearing the uncertainty in the insurance cash flows that arises from non-financial sources, such as the uncertainty in mortality rates, morbidity rates, or accident frequency. This risk adjustment depends on the insurer's risk aversion, which depends on its size, management strategy, and diversification, so it varies among insurers.[3]

The risk adjustment for financial risk depends on the characteristics of the underwriting cash flows:

- For nominal cash flows that do not vary based on the returns on any underlying assets, the discount rate is a risk-free rate and the financial risk stems from the duration, currency, and liquidity of the cash flows.
- For payments to policyholders that depend on the expected return from a specified pool of assets, the discount rate is the expected return on this pool of assets and financial risk includes market risks and credit risks.[4] The payments to policyholders need not be tied to the return on a specified pool of assets by the provisions of the insurance contract, as long as they depend on this return. For instance, the insurer may set the crediting rate for the policyholder account balance as the return on a specified pool of assets minus a margin of 150 basis points, but it may adjust the crediting rate to meet competitive pressures from other insurers or to cover internal costs of managing the insurance contracts. The insurer's right to exercise its discretion and vary the crediting rate does not prevent the payments to policyholders from varying with the expected return on a specified pool of assets.

The risk adjustments for financial risk and non-financial risk both affect the fulfilment cash flows but they are reported separately:

- The risk adjustment for financial risk affects the discount rate used to determine the present value of future cash flows, and changes in financial risk affect insurance finance income or expense, not insurance service expense.[5]
- The risk adjustment for non-financial risk is a part of the fulfilment cash flows, and changes in the risk adjustment for non-financial risk affect insurance service expenses and insurance revenue.[6]

The discount rate should include the effects of financial risk only, not the risk adjustment for non-financial risk. Financial economists and actuaries often use capitalization rates for business projects and discount rates for insurance liabilities that depend on both financial risk and non-financial risk; IFRS 17 requires a separate, explicit assessment of the risk adjustment for non-financial risk.[7]

Illustration: A financial analyst estimating the net present value of an insurer from its expected dividends to shareholders uses a discount rate that depends on its systematic risk from financial or non-financial sources.

The reconciliation of the insurance contract liability required by paragraph 101 (the "source of changes in the fulfilment cash flows" or "the movements in the insurance contract liabilities analyzed by components") shows separate columns for the present value of the future cash flows and for the risk adjustment for non-financial risk. Insurers report insurance finance income or expense on the present value of future cash flows and on the contractual service margin, but not necessarily on the risk adjustment for non-financial risk.[8]

Insurers must disclose how they calculate the risk adjustment for non-financial risk.[9] If they use a method other than the confidence level method, they must disclose the confidence level implied by the risk adjustment.[10]

Changes in the risk adjustment for non-financial risk

Changes in the risk adjustment for non-financial risk are like changes in the estimated values of claims.

- If the changes relate to future service (the claims have not yet occurred), they have offsetting effects on the fulfilment cash flows and the contractual service margin (if the insurance contracts are not onerous and do not become onerous). If the insurance contracts are onerous or become onerous, the risk adjustment for non-financial risk is allocated between the liability for remaining coverage excluding the loss component and the loss component of the liability for remaining coverage in the same manner as the present value of future cash flows.
- If the changes relate to current service (the claims occur during the statement year), the release of the risk adjustment for non-financial risk is reported as insurance revenue under the liability for remaining coverage. For death benefits on life insurance contracts, the claim payments are not uncertain once the claim occurs, and no risk adjustment for non-financial risk would be reported under the liability for incurred claims. If the claim payment is still uncertain after the claim occurs, as if true for many liability insurance

claims, a risk adjustment for non-financial risk would be reported as insurance service expense under the liability for incurred claims.
- If the changes relate to past service (claims that have already occurred but are still unpaid), the changes are insurance service expense under the liability for incurred claims.[11]

Illustration: A two-year insurance contract is issued on January 1, 20X1. Premium of 200 is received at initial recognition and one claim of 210 is expected to occur on December 31, 20X2, and to be paid on December 31, 20X3. The risk adjustment for non-financial risk is 15 from initial recognition until the claim is settled; it does not accrete interest and it does not change when the claim occurs. The discount rate is 6% *per annum*. The acquisition cash flows are zero (for simplicity).

The fulfilment cash flows at initial recognition are $-200 + 210 / 1.06^3 + 15 = -8.68$, so the insurance contract is not onerous and the contractual service margin at initial recognition is 8.68. If the coverage units are the same in 20X1 and 20X2 and the estimated values of the claim and of the risk adjustment for non-financial risk do not change, the allocation of the contractual service margin to profit or loss for 20X1 and 20X2 is

- 20X1: $½ \times 8.68 \times 1.06 = 4.60$
- 20X2: $½ \times 8.68 \times 1.06^2 = 4.88$

On December 31, 20X2, the insurer reports

- Liability for remaining coverage excluding the loss component:
  - insurance revenue of $-210 / 1.06^1 = -198.11$: consideration for present value of claim payment
  - insurance revenue of -15: release of the risk adjustment for non-financial risk
  - insurance revenue is a negative entry in the IFRS 17 reconciliation exhibits.
- Liability for incurred claims:
  - insurance service expense of $210 / 1.06^1 = 198.11$: present value of claim payment
  - insurance service expense of 15: risk adjustment for non-financial risk
  - insurance service expense is a positive entry in the IFRS 17 reconciliation exhibits.

In 20X3, the insurer reports insurance finance expense of $210 \times (1 - 1.06^1) = -12.60$.

On December 31, 20X3, the claim payment equals the expected value of 210.

- The insurance service expense for the claim payment is zero.
- The risk adjustment for non-financial risk becomes zero and is reported as a contra-expense of -15. This release of the risk adjustment for non-financial risk relates to past services (the claim already occurred), so it is not reported as insurance revenue.
- The cash outflow of 210 reduces the insurance contract liability for incurred claims by 210.

RISK ADJUSTMENTS AND RISK MARGINS

IFRS 17 defines the risk adjustment for non-financial risk as "the compensation an entity requires for bearing the uncertainty about the amount and timing of the cash flows that arises from non-financial risk …"[12]

We distinguish three types of risk adjustments and risk margins:

A. the capital that an insurer must hold to support claim payments even in adverse scenarios
B. the difference between the market value and the risk-free present value of an asset or liability
C. the extra income a person requires for uncertainty

The IFRS 17 risk adjustment for non-financial risk is the third type of risk adjustment listed above: a margin for uncertainty that depends on risk aversion.

Regulatory capital requirements

Part A: Regulatory capital requirements are the capital that insurers hold to pay claims in adverse scenarios. Solvency II in the European Union and the Swiss Solvency Test in Switzerland use value at risk or tail value at risk to determine these capital requirements. Regulatory capital formulas in many countries use similar value at risk or tail value at risk measures. Capital requirements are IFRS equity, not liabilities; they are the insurer's own funds, not money owed to policyholders, claimants, or other parties.

Some accounting systems require insurers to add provisions for adverse deviation to the claim liabilities, either as higher claim amounts or as lower discount rates. Provisions for adverse deviation have the same purpose as capital requirements, but they are reported as part of the claims liability, not as equity. IFRS 17 requires best estimates of future cash flows and discount rates. Insurers may not hold claim estimates above the mean of the claim distribution or use discount rates lower than the risk-free rate. The risk adjustment for non-financial risk is a separate, explicit part of the insurance contract liability.

IFRS 17, *Basis for Conclusions*, paragraph BC209, explains that the risk adjustment for non-financial risk is *not* a regulatory capital margin: "a risk adjustment for non-financial risk is not an amount that would provide a high degree of certainty that the entity would be able to fulfil the contract. Although such an amount might be appropriate for some regulatory purposes, it is not compatible with the Board's objective of providing information that will help users of financial statements make decisions about providing resources to the entity."

Fair value risk margins

Part B: Fair value risk adjustments are the difference between the market value of an asset or liability and the present value of the asset or liability discounted at a risk-free rate. Asset pricing models, such as the Capital Asset Pricing Model, arbitrage pricing models, and the Fama-French multi-factor pricing models, estimate fair value risk adjustments.[13]

Illustration: If the present value (at risk-free interest rates) of future dividends from a stock is 80 and the market price of the stock is 100, the fair value risk adjustment is 100 – 80 = 20. In practice, future dividends from common stock are hard to predict, so the present value of these dividends is unknown, and the fair value risk adjustment is not observed in market data.

Some economists extended the Capital Asset Pricing Model to insurance, estimating discount rates by line of business based on the covariance of the underwriting cash flows with overall market returns. They reasoned that some lines of business have higher discount rates because their underwriting cash flows are positively correlated with market returns on financial assets, not because the insurers selling these lines of business have higher risk aversion.[14]

The justification for asset pricing models is the risk aversion of diversified investors, who avoid uncertainty in their overall market returns; it is not the risk aversion of specific insurers, who avoid uncertainty in the cash flows of their own underwriting portfolios. The fair value of an insurance contract, or the premium demanded by the insurer to issue the contract, depends on the overall risk aversion of diversified investors, who offset random fluctuations in underwriting cash flows with fluctuations in the cash flows from other investments.

IFRS 17, *Basis for Conclusions*, paragraph BC209, explains that the risk adjustment for non-financial risk is not a fair value risk adjustment:

> *a risk adjustment for non-financial risk should not represent the compensation that a market participant would require for bearing the non-financial risk that is associated with the contract. … the measurement model is not intended to measure the current exit value or fair value, which reflects the transfer of the liability to a market participant. Consequently, the risk adjustment for non-financial risk should be determined as the amount of compensation that the entity—not a market participant—would require.*

Mainstream financial theory assumes that insurers, like other firms in competitive markets, are price-takers. The amount of compensation they require to write an insurance contract is the fair value of the contract. An insurer with greater risk aversion does not charge a higher premium for the insurance contract.

Similarly, economists assume that the risk aversion of individual firms does not affect prices in competitive markets. A higher price (a higher policy premium) reduces the quantity of insurance sold, and insurers – like all firms – seek to maximize their net income.

- If the net income from a higher price and lower quantity falls, no insurer charges the higher premium.
- If the net income rises, all insurers charge the higher price, regardless of their risk aversion.

Risk aversion

Part C: IFRS 17 paragraph 37 says[15]

> *An entity shall adjust the estimate of the present value of the future cash flows to reflect the compensation that the entity requires for bearing the uncertainty about the amount and timing of the cash flows that arises from non-financial risk.*

IFRS 17 paragraph B87 explains that "the risk adjustment for non-financial risk for insurance contracts measures the compensation that the entity would require to make the entity indifferent between:

(a) fulfilling a liability that has a range of possible outcomes arising from non-financial risk; and
(b) fulfilling a liability that will generate fixed cash flows with the same expected present value as the insurance contracts."[16]

IFRS 17 assumes that insurers are risk averse, and the risk adjustment for non-financial risk depends on the risk aversion of the insurer. Some actuaries have tried to quantify the risk aversion of insurers and to relate this risk aversion to characteristics of the insurer (size and diversification) or of the insurance contracts, such as the frequency and severity of claims.[17]

IFRS 17 paragraph B87 illustrates this risk aversion as "For example, the risk adjustment for non-financial risk would measure the compensation the entity would require to make it indifferent between fulfilling a liability that – because of non-financial risk – has a 50% probability of being 90 and a 50% probability of being 110, and fulfilling a liability that is fixed at 100." IFRS 17 paragraph B87 justifies explicit reporting of the risk adjustment for non-financial risk as "the risk adjustment for non-financial risk conveys information to users of financial statements about the amount charged by the entity for the uncertainty arising from non-financial risk about the amount and timing of cash flows."[18]

Risk aversion depends on the person; insurers have many owners and managers with differing risk aversion. Financial economists assume that the risk aversion of an investor does not affect the price the investor pays for assets, though it does affect the choice of assets held by the investor and the types of securities issued.[19]

Similarly, the risk aversion of an insurer does not affect the price that it charges for its insurance contracts. The price depends on the demand curve of policyholders and the cost of holding capital to support these contracts. Insurers with higher risk aversion do not charge more for their insurance contracts; if they could sell their contracts at a higher price, other insurers would also sell their contracts at the higher price.[20]

MEASURING THE RISK ADJUSTMENT FOR NON-FINANCIAL RISK

IFRS 4, the predecessor of IFRS 17, specified three techniques to measure the risk adjustment:

- a confidence level approach, often interpreted as a value at risk method
- a cost of capital method

! a third method generally viewed as a tail value at risk method

IFRS 17 mentions the confidence level method and the cost of capital method, but it does not require insurers to use them and it does not explain how they should be used.[21]

Confidence level approach

IFRS 17 paragraph 117 and IFRS 17 *Basis for Conclusions* paragraphs BC215-216 mention the confidence level method to quantify the risk adjustment for non-financial risk, and IFRS 17 *Basis for Conclusions* paragraph BC217 mentions the cost of capital method to quantify the risk adjustment for non-financial risk. These IFRS 17 paragraphs discuss the disclosure requirements; they assume the reader knows how to apply the confidence level and cost of capital methods. We explain these methods below.

The confidence level technique sets the risk adjustment so that the fulfilment cash flows (the expected claim payments plus the risk adjustment for non-financial risk) have a specified probability that they will suffice to pay the claims. A 99% confidence level means the expected claim payment plus the risk adjustment for non-financial risk suffice to pay the claim in 99% of scenarios. The confidence level is called the value at risk: a P% confidence level means the insurer is at risk of not fully paying the claim in 1 – P% of scenarios.[22]

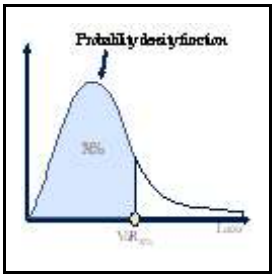

Figure **1**: Value at risk

For claim distributions that are highly skewed, with no claims (or small claims) in many scenarios and large claims in a few scenarios, some actuaries use tail value at risk (or conditional value at risk) instead of value at risk. Tail value at risk is often used to price reinsurance contracts and catastrophe covers, since it gives the cost of the high layer of loss, not just the probability that a large loss will occur.

! Value at risk considers how many claims exceed a retention, but not the cost of the claims above the retention. Value at risk measures the likelihood that an insurer will become insolvent, not the cost to the policyholders or to the claimants of this insolvency.
! Tail value at risk considers the average cost of the claims that exceed a retention. It measures the cost of an excess-of-loss (stop-loss) reinsurance contract or an excess-of-loss catastrophe cover, or the cost to policyholders and claimants from the insurer's insolvency.

Confidence level techniques (value at risk and tail value at risk) are commonly used for surplus requirements. The Swiss Solvency Test uses a 99% tail value at risk, and Solvency II uses a 99.5% value at risk. Surplus requirements are equity, not liabilities; they are the insurer's own capital, not the insurance contract liability for unpaid claims.[23]

The confidence level approach measures the loss from the present value of the future cash flows at a given percentile. A risk adjustment for non-financial risk of 100 based on a 90% confidence level means that in 1 – 90% = 10% of scenarios, the true present value of future cash flows will be at least 100 greater than the estimated present value of the future cash flows (the mean of the distribution of present values).

The Basel II/III accords base regulatory capital requirements for banks on a 99% value at risk or a 97.5% conditional value at risk (the expected shortfall in Basel III terms).[24] Solvency II sets required capital at a 99.5% value at risk: in 99.5% of scenarios, the assets backing the technical reserves plus the required capital will suffice to pay the future cash flows (claims).[25]

A related risk measure is the conditional value at risk (or tail value at risk): the average loss at the confidence level. The Swiss Solvency Test sets required capital at a 99% tail value at risk: in the worst 1% of scenarios, the assets backing the technical reserves plus the required capital will suffice to pay the future cash flows.[26]

! The value at risk computes the lower bound of the loss at the confidence level.

- The conditional value at risk (tail value at risk) computes the average loss at the confidence level.

Regulatory capital requirements (Basel II/III, Solvency II, Swiss Solvency Test) use stringent confidence levels, such as a 99.5% value at risk (a 0.5% probability that the insurer will not have enough capital to pay its claims) or a 99% tail value at risk (a 1% probability that the average claims will exceed the insurer's capital). The confidence level balances the benefits of solvency for policyholders against the costs of holding extra capital.

The IFRS 17 risk adjustment for non-financial risk is the value of the claims to a risk averse insurer. A risk adjustment for non-financial risk at a Z% confidence level means that the insurer is indifferent between the uncertain claim liability and a liability for known claims at the higher (Z% confidence level) amount.

Risk aversion varies inversely with wealth: wealthy persons are less risk averse than poor persons are. A poor person may be willing to trade 110 for an uncertain liability of either 0 or 200 (with equals probabilities), but a wealthy person may be willing to trade only 105 for the same uncertain liability. A poor person may become bankrupt by a large but uncertain liability and is more willing to pay an extra amount to avoid bankruptcy.

Insurers hold much capital and are unlikely to become insolvent. An insurer with uncertain liabilities of 100 may hold 100 of capital, with a 99.8% value at risk, and a 0.2% probability of becoming insolvent. Given its low risk of insolvency, the insurer may be willing to trade its uncertain liabilities for a fixed value only slightly more than the mean of the claim distribution.[27]

Value at risk and tail value at risk depend on the probability distribution of the claims. Skewed distributions and extreme value distributions have high value at risk and high tail value at risk. Normal distributions are often used for interest rate risk and mortality risk; skewed distributions, such as lognormal distributions, are often used for market risk, liability insurance risk, and reinsurance risk.

For a simple explanation of value at risk and tail value at risk, we assume a uniform distribution of claims over 0 to 100: the future claim amount has a constant probability for values from 0 to 100 (the death benefit is 100 and the likelihood of death for a one-year insurance contract is uniform from 0% to 100%).

- The mean claim is ½ × (0 + 100) = 50.
- The 99.5% value at risk is 99.50, so the required capital at a 99.5% value at risk is 99.50 – 50 = 49.50.
- The 99% tail value at risk is the average loss in the worst 1 – 99% = 1% of scenarios = ½ × (49 + 50) = 49.50, so the required capital at a 99% tail value at risk is 49.50.[28]

The IFRS 17 risk adjustment for non-financial risk is the amount the insurer would pay to avoid the uncertainty in the claim liability. A confidence level of 60% is a loss of 60 in this simple illustration, so the risk adjustment for non-financial risk at a 60% confidence level is 60 – 50 = 10.

The confidence level approach depends on the risk aversion of the insurer. A highly risk averse insurer may be willing to pay more to avoid the uncertainty of unknown losses (such as a 70% value at risk) than a less risk averse insurer is willing to pay.

The risk adjustment for non-financial risk affects the timing of the recognition of income, not the price of the insurance contracts or the net present value of the insurance contracts. A higher risk adjustment for non-financial risk does not increase the cost of the claims or the premium received for the insurance contracts; it simply moves an accounting entry from capital to a liability. The choice of claim liabilities vs capital – if the liability is an accounting entry that will not be paid, not an actual claim payment – depends on how the insurer wishes to present its financial statements, not on its risk aversion.

Measuring value at risk

The value at risk may be measured by observed losses (historical data) in past years, an assumed probability distribution of losses, or stochastic simulation of potential losses.

Observed losses (historical data): Value at risk is commonly used for the trading desks of commercial banks and brokerage firms. Daily returns on common stocks have extensive past data that reasonably predict future returns. To estimate its value at risk for the market value losses over the next week on a portfolio of common stocks, a bank may examine the weekly losses for similar portfolios in past years. Stock returns do not depend on the investor holding the stock, so a bank would use overall market experience for many years. Trades of stock shares are reported daily, so the experience of 50 years would have 50 × 200 = 10,000 days, with trades of thousands of stocks each day.[29]

A 99.5% value at risk for insurance losses over the coming year cannot be derived from historical data, as a 99.5% value at risk is a 1 in 200 year event, and data for such losses are not available for long periods. The data for insurance losses differ by insurer, and historical experience for any one insurer may not be credible.

A 60% value at risk, as might be used for the risk adjustment for non-financial risk, is the 18th worst year in the past 30, which insurers can evaluate. But even the 60% value at risk derived from historical experience may be distorted by random loss fluctuations.

Probability distributions: If the insurer knows the shape of the probability distribution of its future claims, it can derive the value at risk at any confidence level. For a normal distribution, the probability of a loss two standard deviations above the mean is about 2.5%, so if the future claims are normally distributed with a mean of 100 and a standard deviation of 20, the 97.5% value at risk is about 100 + 2 × 20 = 140.[30]

Insurance claims have skewed distributions, with higher values at risk than implied by a normal distribution at the tails of the distribution (high values at risk). For a 99.5% value at risk, as used for capital requirements, Solvency II uses a lognormal distribution, not a normal distribution. For a 60% value at risk, as might be used for IFRS 17 risk adjustments for non-financial risk, the normal distribution gives reasonably accurate figures.

Stochastic simulation: For claims with low frequency and high severity, such as commercial liability claims and reinsurance claims, and for claims with simultaneous losses to many risks, such as natural catastrophes and epidemics, insurers often use stochastic simulation based on estimated probabilities of the variables that influence the insured event. For hurricanes, an insurer might model air pressure, ocean temperature, wind speed, landfall location, and similar attributes. Insurers with catastrophe exposures generally have catastrophe models to compute the value at risk or the tail value at risk.

Deriving risk adjustments for non-financial risk by the confidence level approach

Estimating confidence levels from first principles is difficult. Insurers many not have the expertise or the data to compute the value at risk for a given confidence level by groups of insurance contracts. Estimates derived by different actuaries vary widely; private estimates by insurers may not be accurate.

Solvency II estimates the 99.5% value at risk by type of risk and line of business from industry-wide data. The Solvency II calculations are based on extensive actuarial and financial estimates, and they are accepted by regulators and auditors. The capital formulas in several other countries are also based on extensive analysis and are similarly accepted.[31]

An insurers may derive its value at risk for any confidence level from the 99.5% value at risk in Solvency II or the value at risk in another regulatory capital formula.

Illustration: An insurer wishes to compute its value at risk at a 60% confidence level. For simplicity, we use the cumulative distribution function for a normal distribution; actual estimates use the cumulative distribution function for the future cash flows, which may be more skewed.

- a 99.5% cumulative distribution function corresponds to 2.576 standard deviations above the mean
- a 60% cumulative distribution function corresponds to 0.253 standard deviations above the mean

A P% cumulative distribution function means a P% probability that the actual loss will be equal to or less than the mean of the distribution plus the stated number of standard deviations.

If an insurer's regulatory capital requirement uses a 99.5% value at risk, its value at risk for a 60% confidence level is 0.253 / 2.576 = 9.8% of its regulatory capital requirement.

The relative sizes of the risk adjustment for non-financial risk and the regulatory capital requirement in the preceding paragraph are realistic. The risk adjustment for non-financial risk derived by the cost of capital method is about 4% to 6% of the capital supporting the unpaid claims; this capital is generally about two times the regulatory capital requirement. The risk adjustment for non-financial risk is ½ × (4% + 6%) × 2 = 10% of the capital requirement. The cost of capital method gives a fair value risk margin and an objective estimate of the risk adjustment for non-financial risk. Estimating the risk adjustment for non-financial risk from first principles using the confidence level approach is both costly and highly influenced by random loss fluctuations. Many insurers may base their risk adjustments for non-financial risk on their regulatory capital requirements, which satisfies the cost of capital method and provides an inexpensive and objective confidence level.[32]

To derive the risk adjustments for non-financial risk based on the confidence level approach, insurers may allocate their regulatory capital requirement (based on Solvency II or another regulatory formula) by group of insurance contracts. The allocation percentages may be derived from the Solvency Capital Requirement (or a similar capital formula).

Illustration: An insurer has two groups of insurance contracts. The volume of business (based on the amount of insurance in force) is three times as large for Group A as for Group B, and the capital requirement (per unit of coverage) for Group A is 80% of that for Group B. If the insurer's total capital requirement (given its overall diversification) is 100, its allocation percentages by group are

- Group A: 80% × 3 / (1 × 100% + 3 × 80%) = 70.59%
- Group B: 100% × 1 / (1 × 100% + 3 × 80%) = 29.41%

Its capital requirement by group (given its overall diversification) is

- Group A: 100 × 80% × 3 / (1 × 1 + 3 × 80%) = 70.59
- Group B: 100 × 100% × 1 / (1 × 1 + 3 × 80%) = 29.41

These capital requirements correspond to a 99.5% value at risk. The risk adjustments for non-financial risk at a 60% confidence level (using the 9.8% ratio for a normal distribution) are

- Group A: 9.8% × 100 × 80% × 3 / (1 × 1 + 3 × 80%) = 6.92
- Group B: 9.8% × 100 × 100% × 1 / (1 × 1 + 3 × 80%) = 2.88

The computation above assumes a normal distribution for the risks. Solvency II uses a lognormal distribution for many underwriting risks, such as premiums and claims. The lognormal distribution raises the 99.5% value at risk more than it raises the 60% value at risk, so the risk adjustments for non-financial risk using the lognormal distribution are lower than the values computed above for a normal distribution.

The confidence level method for determining the risk adjustment for non-financial risk implies that insurers select a confidence level (such as 60%) representing their degree of risk aversion and a probability distribution (such as a lognormal distribution) for claims to derive the risk adjustment. But risk aversion reflects a person's behavior; it is not computed from mathematical models, confidence levels, and probability distributions. The risk aversion is determined by the amount a person will pay to avoid uncertainty or the price a person charges to assume uncertainty. An insurer does not assume a particular confidence level and derive the cost of its risk aversion. Rather, the senior managers of the insurer estimate the fixed liabilities they would assume to replace the uncertainty of future cash flows. For the illustration above, the insurer may be willing to pay 9.8 to eliminate the uncertainty of the future cash flows. The behavior of the insurer implies a confidence level of 60%.

Deriving the confidence level

We distinguish regulatory capital requirements, which are equity, from the IFRS 17 risk adjustment for non-financial risk, which is a liability.

The Solvency Capital Requirement of Solvency II uses a 99.5% value at risk, and the standard formula of the Swiss Solvency Test uses a 99% tail value at risk, which is about the same size. These formulas give the required capital for the insurer, which is not part of the insurance contract liability. Regulatory capital formulas in other countries often use similar value at risk or tail value at risk measures.

The IFRS 17 risk adjustment for non-financial risk is part of the insurance contract liability. It differs from other liabilities in that it is not a market value, it need not reflect future cash outflows, and it depends on attributes of the insurer, such as its diversification and risk aversion.

- The required regulatory capital is shown "below the line" separating liabilities from equity.
- The risk adjustment for non-financial risk is shown "above the line" separating liabilities from equity.
  - The risk adjustment converts part of the required regulatory capital into an IFRS 17 liability,

Illustration: The present value of future cash outflows is 200, the required regulatory capital is 100, and the insurer holds total liabilities plus capital of 300. If the IFRS 17 risk adjustment for non-financial risk is 20, the insurer's insurance contract liability is 220 and its shareholders' equity is 80.

The IFRS 17 risk adjustment differs from a liability for future claim payments:

- A higher liability for future claim payments raises the regulatory capital requirement, so the equity needed "below the line" to meet capital requirements increases.
- A higher risk adjustment for non-financial risk does not affect the regulatory capital requirement. The equity needed "below the line" to meet capital requirements decreases, since part of that equity is the risk adjustment for non-financial risk.

Solvency II uses a 99.5% value at risk (confidence level), and a 6% annual cost of holding capital. We relate the risk adjustment for non-financial risk determined by the cost of capital method to the Solvency II required capital. The confidence level corresponding to the risk adjustment for non-financial risk determined by the cost of capital method depends on

- The ratio (R) of supporting capital (the capital held) to the Solvency II required capital
- The annual cost of holding capital (A%)
- The time to settlement (N) of the unpaid claims.

Illustration: If R = 150%, A% = 6%, and N = 5 years, the cost of capital risk adjustment for non-financial risk is 150% × 6% × 5 = 45% of the Solvency II required capital. The confidence level depends on the distribution of the future claim payments. If the future claim payments are normally distributed:

- a 99.5% cumulative distribution function corresponds to 2.575 standard deviations above the mean
- 45% of the Solvency II required capital is 45% × 2.575 = 1.159 standard deviations above the mean
- 1.159 standard deviations above the mean corresponds to an 87.7% cumulative distribution function.

The illustration above is heuristic. Solvency II assumes a lognormal distribution for future claim payments, so the arithmetic to derive the confidence level differs, but the intuition is the same as in the illustration above.

Insurers must disclose the confidence interval for the risk adjustment for non-financial risk, even if they do not use the confidence level method to derive the risk adjustment. If the insurer has the statistical expertise, it may quantify the confidence level from the distribution of its future claim payments.

Alternatively, the insurer may compare its total risk adjustment for non-financial risk for all insurance contracts combined to its required regulatory capital, such as its Solvency Capital Requirement. Solvency II quantifies the uncertainty based on the distribution of future claim payments, dependencies among types of risk, and the diversification of the insurer. The ratio of the capital held to the required capital gives the confidence level, as in the illustration above.

THE COST OF CAPITAL METHOD

Solvency II and the Swiss Solvency Test use a cost of capital method to provide a fair value risk margin for technical reserves (the liabilities for future claim payments). The cost of capital method is the cost of holding the capital needed to support insurance operations. This cost is imposed by regulatory capital requirements because of the uncertainty of the future claim payments.[33]

Accretion of interest on the risk adjustment for non-financial risk

Some exercises view the risk adjustment as compensation for the insurer's risk aversion.

- The risk adjustment for non-financial risk at initial recognition is eventually added to the insurer's profit.
  - The insurer requires this risk adjustment as compensation for its risk aversion, so it is not yet profit.
- The risk adjustment for non-financial risk is released as the claim uncertainty decreases.
  - The insurer does not accrete interest on its risk aversion.

Actuarial pricing models often assume the risk adjustment accretes interest. The Society of Actuaries text on *Life Insurance Products and Finance* (Atkinson and Dallas [2000]) assumes the risk-based capital charge is used at the end of the year (the balance sheet date). The insurer allocates the present value of this charge at policy inception and accretes interest during the year. The cost of capital method used in Solvency II and the Swiss Solvency Test conceives of the fair value risk margin on technical reserves as

- the present value at initial recognition
- insurance finance expense during the coverage period
- the release of the nominal value when the claims occur and are paid

IFRS 17 allows both methods of reporting the risk adjustment for non-financial risk. IFRS 17 does not specify how to estimate the risk adjustment, so it does not say whether the risk adjustment is the present value at initial recognition and increases to the nominal value by the time the claims occur or stays the nominal value for the entire time until the claims occur.

The cost of capital method: three inputs

The cost of capital method computes the risk adjustment for non-financial risk from the annual cost of holding capital, the timing of the unpaid claims, and the supporting capital as a percentage of the technical reserves.

The *annual cost of holding capital* is the return on capital expected by investors in insurance companies minus the after-tax investment yield on the capital held by insurers.

Insurance companies have about average market risk, so the return on capital for insurance is about the same as the average return on capital for the overall stock market.

(A) The return on capital for insurers is estimated three ways: empirical data (past returns), correlations with economic cycles, or inferences from insurers' assets and liabilities.

(1) Empirical data: Stock returns in recent years have been below average for property-casualty insurers and about average for life insurers in North America and Western Europe. Some analysts presume (on the basis of CAPM estimates) that the return on capital for life insurance is somewhat higher than this average and the

return on capital for general insurance is somewhat lower than this average. But the CAPM evidence is highly uncertain and the CAPM betas are not consistent from year to year.[34]

(2) Business cycle correlations: Systematic risk is high when profitability of the industry is strongly correlated with that of the overall economy, and systematic risk is low when the correlation is weak.

- Durable goods (autos, houses) and luxury goods (jewelry, international travel) have strong correlations, since people buy durable goods and luxury items when the economy is strong. Construction and heavy manufacturing are cyclical industries, with high systematic risk and high rates of return.
- Food staples and everyday clothes have weak correlations with business cycles, since sales do not vary much with the economy. They are low risk industries with lower than average rates of return.

The demand for property casualty insurance follows the goods insured. Demand for motor insurance follows the number of autos; demand for home insurance follows the number of homes. Demand for motor insurance and home insurance expands in *developing economies* as people buy autos and houses, especially if motor insurance is mandated by law and property insurance is required by banks. But this demand levels off in more developed countries, since the number of cars or homes in use is less affected by current sales. Demand may even decline as autos become safer and homes are better constructed. Property-casualty claims are not related to the economy, so systematic risk and expected returns on capital should be below average.

Demand for life insurance and annuities is low in less developed countries where most people are concerned with meeting basic needs for food, clothing, and shelter. In developed countries, life insurance and annuities have tax exemptions creating a demand that is positively correlated with prosperity. People buy life insurance as tax advantaged savings plans for dependents when they feel wealthier.

(3) Betas of assets and equity: The assets to capital ratio affects systematic risk and rates of return. Most firms' liabilities are long-term debt with little systematic risk. For these firms, some economists say that

the systematic risk of equity = the systematic risk of assets × the assets to capital ratio.

A higher ratio of assets to capital increases the systematic risk of equity and the required rate of return.

Investment risk of insurers amplifies the business risk from correlations with economic cycles. Life insurance has long-duration reserves (long loss payment lags), so it has a high ratio of assets to premium. It has low capital charges for underwriting risk in regulatory capital formulas (such as RBC and Solvency II) and in rating agency capital standards, so it has a high premium to capital ratio. Assets/premium × premium/capital = assets/capital, so the high assets to premium ratio times the high premium to capital ratio gives a high asset to capital ratio. Even the conservative (low risk) investments held by life insurers may lead to high systematic risk of equity.

Property-casualty insurers have shorter-duration reserves, low ratios of assets to premium, and high capital charges for underwriting risk, so they have low premium to capital ratios. Low assets to premium ratios times low premium to capital ratios gives low asset to capital ratios. With conservative investments (government bonds and investment grade corporate bonds), property-casualty insurers have less investment risk.

(B) The after-tax investment yield on the capital held by insurers varies by country (tax regime) and currency. An estimate of the after-tax investment yield is the risk-free rate for the currency × $(1 - \tau)$, where τ is the corporate income tax rate.[35]

(C) The supporting capital is generally expressed as a percentage of the technical reserves (the present value of the future claim payments at a risk-free rate). For ease of computation, the supporting capital may be a percentage of nominal reserves (undiscounted claims).

For the fair value risk margin in Solvency II, the supporting capital is the required capital from the Solvency Capital Requirement.[36] For the IFRS 17 risk adjustment for non-financial risk, the supporting capital is what the insurer believes it should hold to support the claims.[37]

Capital markets are efficient, so excess capital held by firms is soon moved to projects where it earns higher returns, and firms with not enough capital to fund the available business soon raise more capital or other firms enter the industry to compete for their business. This market efficiency implies that the average capital held by insurers is a reasonable estimate of the capital needed to support insurance operations. This average capital is substantially higher than the required regulatory capital in most countries.[38]

In the European Union and many other countries, insurer must file own risk and solvency assessment (ORSA) reports showing the capital they believe they should hold. These ORSA estimates, which may be based on value at risk, tail value at risk, or other measures, are especially useful if the insurer believes the estimates based on required regulatory capital are not appropriate for its business.[39]

The cost of holding capital is present value of the the annual cost × the length of time the capital is held. If the supporting capital is a percentage of the technical reserves, the risk adjustment for non-financial risk derived by the cost of capital method is

average loss lag × *annual cost of holding capital* × *supporting capital as a percentage of technical reserves* × *the present value of the reserves for future claims and for unpaid claims*

Illustration: The discount rate is 5% *per annum*, the annual cost of holding capital is 6%, the supporting capital is 8% of the technical reserves, and a claim for 100 will be paid in 3 years. The cost of holding capital is

$$\sum_{t=1,2,3} 8\% \times 100 \times 1.05^{-(3-t)} \times 6\% \times 1.05^{-t} = 3 \times 8\% \times 6\% \times 100 \times 1.05^{-3}.$$

The cost of holding capital is an annual cost, and the fair value risk margin for unpaid claims is the present value of these annual costs until the claim is paid.

Illustration: Cost of capital method for a single claim

An insurance contract issued on December 31, 20X0, has one expected claim for 100 on December 31, 20X3.

The insurer uses the cost of capital method to derive the risk adjustment for non-financial risk.

- The cost of capital is the after-tax risk-free rate + 6%.
- The risk-free discount rate is 5% *per annum*.
- The supporting capital is 20% of the technical reserves (the present value of future claim payments).

For the fair value risk margin in Solvency II, the supporting capital is the required capital from the Solvency Capital Requirement. For the IFRS 17 risk adjustment for non-financial risk, the supporting capital is what the insurer holds (or believes it should hold) to support the claims.[40] We derive

A. The present value of the claim at the beginning of each year
B. The supporting capital for the claim each year
C. The annual cost of holding capital
D. Each year's cost of holding capital for the claim
E. Each year's risk adjustment for non-financial risk

Part A: The present value of the claim is the nominal value discounted at the risk-free rate:

- January 1, 20X1: $100 / 1.05^3 = 86.38$
- January 1, 20X2: $100 / 1.05^2 = 90.70$

- January 1, 20X3: $100 / 1.05^1 = 95.24$

Part B: The supporting capital changes over time as the present value of the claim increases by the accretion of interest. For 20X1, the supporting capital is 20% × 86.38 = 17.28 on January 1 and 20% × 90.70 = 18.14 on December 31. The increase is the accretion of interest: 17.28 × 1.05 = 18.14.

For simplicity, we use the present value of the claim at the beginning of the year (or at the end of the previous year) to derive the supporting capital for the year. This present value slightly understates the supporting capital, which should increase over the year, but it also overstates the supporting capital for claims that are paid during the year. After the claim is paid, the supporting capital is zero.

Using the present value of the claim at the beginning of the year, the supporting capital is

- 20X1: $20\% \times 100 / 1.05^3 = 17.28$
- 20X2: $20\% \times 100 / 1.05^2 = 18.14$
- 20X3: $20\% \times 100 / 1.05^1 = 19.05$

Part C: For simplicity, this illustration gives the return on capital as the after-tax investment yield plus 6%, so the annual cost of holding capital is 6%. In practice, insurers estimate the return on capital demanded by investors and their after-tax investment yield, and derive the annual cost of holding capital.

Part D: The cost of holding capital each year is

- 20X1: $6\% \times 20\% \times 100 / 1.05^3 = 1.04$
- 20X2: $6\% \times 20\% \times 100 / 1.05^2 = 1.09$
- 20X3: $6\% \times 20\% \times 100 / 1.05^1 = 1.14$

Part E: The risk adjustment for non-financial risk is the sum of the present values (at the risk-free rate) of the future costs of holding capital:

- December 31, 20X0: $1.04 + 1.09 / 1.05^1 + 1.14 / 1.05^2 = 3.11$
- December 31, 20X1: $1.09 + 1.14 / 1.05^1 = 2.18$
- December 31, 20X2: 1.14

Alternatively, we use the loss payment lag to derive the risk adjustment for non-financial risk.

- At December 31, 20X0, the claim has three years to payment, so the risk adjustment is 3 × 1.04 = 3.12.
- At December 31, 20X1, the claim has two years to payment, so the risk adjustment is 2 × 1.09 = 2.18.

The risk adjustment for non-financial risk from the cost of capital method accretes interest each year. The 3.11 risk adjustment at December 31, 20X0, has two parts: 1.04 for the cost of holding capital in 20X1 and $1.09 / 1.05^1 + 1.14 / 1.05^2 = 2.07$ for the cost of holding capital in 20X2 and 20X3.

- The 1.04 for the cost of holding capital in 20X1 is paid to investors or as taxes on December 31, 20X1.[41] When the cost of holding capital is paid, it is released from the insurer's risk adjustment for non-financial risk.
  - The amount released on December 31, 20X1, is 1.04 × 1.05 = 1.09.
  - For IFRS 17, a release of the risk adjustment for non-financial risk when the claim occurs is insurance revenue and is recognized in profit or loss. A release before the claim occurs (as in this case) is an adjustment to the fulfilment cash flows that is offset by an opposite adjustment to the contractual service margin. It is not included in insurance revenue, and it is recognized in profit or loss as the insurance services are provided and the contractual service margin is allocated to profit or loss.
- The $1.09 / 1.05^1 + 1.14 / 1.05^2$ for calendar years 20X2 and 20X3 accretes interest in 20X1 and becomes $1.05 \times (1.09 / 1.05^1 + 1.14 / 1.05^2) = 2.18$ at December 31, 20X1.

! The insurance finance expense during 20X1 for the accretion of interest on the risk adjustment for non-financial risk is 3.11 × 5% = 0.16.

Accretion of interest vs change in estimate

Changes in estimates of unpaid claims are offset by changes to the contractual service margin.

! If the discount rate is zero and the estimated unpaid claim is 86.38 at December 31, 20X0, and 90.70 at December 31, 20X1, the increase in the liability for remaining coverage of 90.70 – 86.38 = 4.32 is offset by a decrease in the contractual service margin of 90.70 – 86.38 = 4.32 and the insurance contract liability does not change.
! If the discount rate is 5% and the estimated nominal value of the unpaid claim does not change, the accretion of interest in the present value of the unpaid claim raises the liability for remaining coverage by 86.38 × 5% = 4.32. This increase of 4.32 is insurance finance expense and is not offset by a reduction of the contractual service margin, so the insurance contract liability increases 4.32.
! For both of the scenarios above, the accretion of interest on the contractual service margin also raises the insurance contract liability, and the allocation of the contractual service margin to profit or loss for the year reduces the insurance contract liability.

IFRS 17 does not require insurers to show accretion of interest on the risk adjustment for non-financial risk. The insurer may show the entire change from 3.11 to 2.18 as a release of the risk adjustment for non-financial risk instead of showing part as accretion of interest. Since the claim has not yet occurred, IFRS 17 treats the release as a re-estimate of the risk adjustment for non-financial risk, which is offset by an opposite change in the contractual service margin.

! If the insurer dis-aggregates the accretion of interest from the release of risk, the accretion of interest is 0.16, the accumulated risk adjustment for non-financial risk is 3.11 + 0.16 = 3.27, the release of risk is 1.09, and the remaining risk adjustment for non-financial risk is 3.27 – 1.09 = 2.18. The contractual service margin increases 1.09 (before the allocation to profit or loss).
! If the insurer does not dis-aggregate the accretion of interest from the release of risk, the accretion of interest is zero and the release of risk is 3.11 – 2.18 = 0.93. The contractual service margin increases 0.93 (before the allocation to profit or loss).

Illustration: Cost of capital method for multiple claims

An insurance contract issued on December 31, 20X0, has three expected claims:

! 200 on December 31, 20X1
! 400 on December 31, 20X2
! 300 on December 31, 20X3

The insurer uses the cost of capital method to derive the risk adjustment for non-financial risk.

! The cost of capital is the after-tax risk-free rate + 6%.
! The risk-free discount rate is 5% *per annum*.
! The supporting capital is 20% of the technical reserves (the present value of future claim payments).

We derive the following items for the cost of capital method:

A. The present value of future claim payments at each year-end
B. The supporting capital at each year-end
C. The annual cost of holding capital
D. The cost of holding this capital each year
E. The cost of capital risk adjustment for non-financial risk at each year-end

F. The accretion of interest on the risk adjustment for non-financial risk each year
G. The release of risk each year

Part A: The present value of future claim payments at the valuation dates below is

- December 31, 20X0: $200 / 1.05^1 + 400 / 1.05^2 + 300 / 1.05^3 = 812.44$
- December 31, 20X1: $400 / 1.05^1 + 300 / 1.05^2 = 653.06$
- December 31, 20X2: $300 / 1.05^1 = 285.71$

Part B: The supporting capital at each year-end is

- December 31, 20X0: $20\% \times (200 / 1.05^1 + 400 / 1.05^2 + 300 / 1.05^3) = 162.49$
- December 31, 20X1: $20\% \times (400 / 1.05^1 + 300 / 1.05^2) = 130.61$
- December 31, 20X2: $20\% \times (300 / 1.05^1) = 57.14$

Part C: The insurer can invest the capital at the risk-free rate, so the cost of holding the capital is the cost of capital minus its after-tax risk-free return = 6% here. To provide a common formula for all insurers, Solvency II and the Swiss Solvency Test prescribe a 6% cost of holding capital regardless of investment yields, risk-free rates, and tax laws. The risk adjustment for non-financial risk in IFRS 17 may use a cost of holding capital specific to the investment yields and tax laws of the insurer's country.

Part D: The cost of holding capital each year is

- December 31, 20X0: $6\% \times 20\% \times (200 / 1.05^1 + 400 / 1.05^2 + 300 / 1.05^3) = 9.75$
- December 31, 20X1: $6\% \times 20\% \times (400 / 1.05^1 + 300 / 1.05^2) = 7.84$
- December 31, 20X2: $6\% \times 20\% \times (300 / 1.05^1) = 3.43$

We assume the capital held each year is the supporting capital at the previous year-end. The actual capital held is slightly greater for accretion of interest and somewhat smaller if claims are paid during the year.

Part D: The cost of capital risk adjustment for non-financial risk at each year-end is the present value of the future costs of holding capital. We have not adjusted for average mid-years dates of holding capital just as we did not adjust for the average half-year accretion of interest: these two half-years partly offset each other.

- December 31, 20X0: $9.75 + 7.84 / 1.05^1 + 3.43 / 1.05^2 = 20.33$
- December 31, 20X1: $7.84 + 3.43 / 1.05^1 = 11.11$
- December 31, 20X2: 3.43

Part E: The accretion of interest each year is

- 20X1: $20.33 \times 5\% = 1.02$
- 20X2: $11.11 \times 5\% = 0.56$
- 20X3: $3.43 \times 5\% = 0.17$

Release of the risk adjustment for non-financial risk

Part F: The release of risk is the risk adjustment for non-financial risk at the beginning of the year plus the accretion of interest during the year minus the risk adjustment for non-financial risk at the end of the year:

- 20X1: $20.33 + 1.02 – 11.11 = 10.24$
- 20X2: $11.11 + 0.56 – 3.43 = 8.24$
- 20X3: $3.43 + 0.17 – 0 = 3.60$

The accretion of interest is insurance finance expense. The release of risk is insurance revenue for the claims that occur during the year and an adjustment to the fulfilment cash flows that is offset by an increase to the contractual service margin for claims that have not yet occurred.

For the 10.24 release of the cost of capital risk adjustment in 20X1:

- The risk adjustment for non-financial risk at initial recognition is $6\% \times 20\% \times 200 / 1.05^1 = 2.29$ (annual cost of holding capital × supporting capital × technical reserves).
- The accretion of interest (insurance finance expense) in 20X1 is $5\% \times 2.29 = 0.11$.
- The $6\% \times 20\% \times 200 = 2.40$ that relates to the 20X1 claim is included in insurance revenue and it is recognized in profit or loss for 20X1.
- The $6\% \times 20\% \times (400 / 1.05^1 + 300 / 1.05^2) = 7.84$ that relates to the 20X2 and 20X3 claims that have not yet occurred is a decrease in the fulfilment cash flows from a re-estimate of the risk adjustment for non-financial risk, so it is offset by an increase in the contractual service margin. It is not included in insurance revenue and is not recognized in profit or loss, though the higher contractual service margin causes a larger allocation to profit or loss for 20X1.

For the 8.24 release of the cost of capital risk adjustment in 20X2:

- The $6\% \times 20\% \times 400 = 4.80$ that relates to the 20X2 claim is included in insurance revenue and it is recognized in profit or loss for 20X2.
- The $6\% \times 20\% \times 300 / 1.05^1 = 3.43$ that relates to the 20X3 claim that has not yet occurred is a decrease in the fulfilment cash flows from a re-estimate of the risk adjustment for non-financial risk, so it is offset by an increase in the contractual service margin. It is not included in insurance revenue and is not recognized in profit or loss, though the higher contractual service margin causes a larger allocation to profit or loss for 20X2.

The 3.60 release of the cost of capital risk adjustment in 20X3 relates to the claim that occurs in 20X3, so it is included in insurance revenue and recognized in profit or loss for 20X3.

Examining the risk adjustment for non-financial risk separately for each claim shows the insurance finance expense vs the insurance revenue. For the 20X1 claim,

- The risk adjustment for non-financial risk at initial recognition is $6\% \times 20\% \times 200 / 1.05^1 = 2.29$ (annual cost of holding capital × supporting capital × technical reserves).
- The accretion of interest (insurance finance expense) in 20X1 is $5\% \times 2.29 = 0.11$.
- The accumulated risk adjustment for non-financial risk of $2.29 + 0.11 = 2.40$ is released when the claim occurs on December 31, 20X1, and is reported in profit or loss as insurance revenue. The release of the risk adjustment for non-financial risk by-passes the contractual service margin since the claim occurs.

For the 20X2 claim, we show the IFRS 17 entries for 20X1 and 20X2:

- The risk adjustment for non-financial risk at initial recognition is $2 \times 6\% \times 20\% \times 400 / 1.05^2 = 8.71$ (claim lag × annual cost of holding capital × supporting capital × technical reserves).
- The accretion of interest (insurance finance expense) in 20X1 is $5\% \times 8.71 = 0.44$.
- The accumulated risk adjustment for non-financial risk at December 31, 20X1, is $8.71 + 0.44 = 9.15$.
- The risk adjustment for non-financial risk needed at December 31, 20X1, is $6\% \times 20\% \times 400 / 1.05^1 = 4.57$. The risk adjustment is re-measured each valuation date. If computed by a confidence level method, the risk adjustment might not change from year to year, but if computed by the cost of capital method, the risk adjustment declines from the passage of time (thought it might increase for other reasons).
- The decrease in the risk adjustment for non-financial risk causes the fulfilment cash flows to decrease by $9.15 – 4.57 = 4.58$, so the contractual service margin increases by 4.58. The claim has not yet occurred (it is future service), so the decrease in the risk adjustment for non-financial risk is unearned profit and is recognizes in proportion to the insurance protection provided.

- If the coverage units are proportional to the estimated claim payments, the amount allocated to profit or loss in 20X1 is 4.58 × 200 / (200 + 400 + 300) = 1.02. The rest (4.58 – 1.02 = 3.56) remains in the contractual service margin, accretes interest, and is allocated to 20X2 and 20X3. Even though the claim occurs in 20X2, the allocation of the contractual service margin applies to the group of insurance contracts and extends over 20X2 and 20X3.
- The remaining risk adjustment for non-financial risk for the 20X2 claim of 4.57 accretes interest of 5% × 4.57 = 0.23.
- The accumulated risk adjustment for non-financial risk of 4.57 + 0.23 = 4.80 is released when the claim occurs on December 31, 20X2, and is reported in profit or loss as insurance revenue.

For the 20X3 claim, we show the IFRS 17 entries for 20X1, 20X2, and 20X3:

- The risk adjustment for non-financial risk at initial recognition is $3 \times 6\% \times 20\% \times 300 / 1.05^3 = 9.33$ (claim lag × annual cost of holding capital × supporting capital × technical reserves).
- The accretion of interest (insurance finance expense) in 20X1 is 5% × 9.33 = 0.47.
- The accumulated risk adjustment for non-financial risk at December 31, 20X1, is 9.33 + 0.47 = 9.80.
- The risk adjustment for non-financial risk needed at December 31, 20X1, is $2 \times 6\% \times 20\% \times 300 / 1.05^2 = 6.53$.
- The decrease in the risk adjustment for non-financial risk causes the fulfilment cash flows to decrease by 9.80 – 6.53 = 3.27, so the contractual service margin increases by 3.27.
- If the coverage units are proportional to the estimated claim payments, the amount allocated to profit or loss in 20X1 is 3.27 × 200 / (200 + 400 + 300) = 0.73. The rest (3.27 – 0.73 = 2.54) remains in the contractual service margin, accretes interest, and is allocated to 20X2 and 20X3.
- The remaining risk adjustment for non-financial risk for the 20X3 claim of 6.53 accretes interest of 5% × 6.53 = 0.33.
- The accumulated risk adjustment for non-financial risk is 6.53 + 0.33 = 6.86 follows the same accounting treatment as the risk adjustment for the 20X2 claim shown above.

Computing capital requirements

The cost of capital method requires the insurer to estimate its supporting capital for the group of insurance contracts. The total supporting capital for the insurer may be estimated as a mark-up on regulatory capital requirements (such as the Solvency Capital Requirement of Solvency II) or may taken from the insurer's own risk and solvency assessment filing. This supporting capital may be allocated by group of insurance contracts using the capital factors in the regulatory capital requirement.

The total supporting capital for future years must be estimated. Solvency II and the Swiss Solvency Test use simplifications: the supporting capital may be a percentage of the technical reserves (or the insurance contract liability). If the insurance contract liability is now 100, the supporting capital is 50, and the insurance contract liability will be 80 in five years, then the supporting capital will be 50 × (80 / 100) = 40 in five years.

CAPITALIZATION RATES AND DISCOUNT RATES

The IFRS 17 fulfilment cash flows are present values at a risk-free discount rate, not at the capitalization rate for the insurance operations, with a separate risk adjustment for non-financial risk. The net present value of the insurance contracts uses a capitalization rate that considers the cost of holding capital that supports the insurance contracts.[42]

- The IFRS 17 discount rate is a risk-free rate, which is less than the cost of capital used for the net present value of corporate projects. An onerous insurance contract has an accounting loss at a risk-free discount rate even without deducting the cost of holding capital to support the insurance operations. A non-onerous contract may not show an accounting loss but may still be unprofitable economically if the cost of holding capital is deducted.

- The fulfilment cash flows include a separate risk adjustment for non-financial risk. The opportunity cost of capital for net present values includes risk adjustments for both financial risk and non-financial risk.
  - For IFRS 17, the risk adjustment for financial risk affects the discount rate and the risk adjustment for non-financial risk is shown separately.
  - The IFRS 17 risk adjustment for non-financial risk is not a fair value risk margin, so it may over- or under-state the market risk of the insurance contracts.

The fulfilment cash flows, expenses, and liabilities are shown as positive entries, as they are in the IFRS 17 *Illustrative Examples*. Most finance textbooks show expenses and liabilities as negative entries and revenue and assets as positive entries, so that positive net present values indicate profits.

The IFRS 17 reconciliation exhibits track the progression of the insurance contract liability. The liability is shown as a positive entry, so assets are shown as negative entries.

- Entries which increase the liability, such as expenses (with no cash outflow) and cash inflows (with no revenue), are positive.
- Entries which decrease the liability, such as revenue (with no cash inflow) and cash outflows (with no expense), are negative.

Premiums are usually received before claims occur. A lower discount rate increases the fulfilment cash flows: negative cash inflows for premiums are not discounted as much as positive cash outflows for claims.[43]

Illustration: Premium of 100 is received at time t=0 and a claim of 110 is paid at time t=1.

- If the discount rate is 10% *per annum*, the fulfilment cash flows = 110 / 1.10 – 100 = 0.
- If the discount rate is 6% *per annum*, the fulfilment cash flows = 110 / 1.06 – 100 = 3.77.

The cost of capital affects the net capital flows; the IFRS 17 discount rate affects (primarily) the cash outflows from the insurer. A higher discount rate applied to cash outflows increases the present value of the project, implying a lower capitalization rate (cost of capital).

Illustration: Premium is received for 100 at time t=0 and invested at a risk-free rate of 10% *per annum* for one year. A claim is paid at time t=1 for 100, and the discount rate is 10% *per annum*, so the fulfilment cash flows at initial recognition are zero.

The insurer's owners contribute supporting capital at initial recognition for regulatory capital requirements or rating agency capital standards, and they receive the capital back from the insurer when the claims settle, plus any profit or loss from the insurance contracts. If the cost of capital is 10% *per annum*, and the supporting capital held is 50, the net present value of the insurance contract is

-50 (the capital formula from owners to the insurer at time t=0)
\+ 50 + 5 (supporting capital held by the insurer plus the investment income plus any profit or loss from the underwriting cash flows) discounted at the cost of capital is $(50 + 5 + 0) / 1.10^1 = 50$
= 0 net present value of the project

- A higher cost of capital with no change to the investment yield reduces the net present value.
- A higher IFRS 17 discount rate with no change to the cash flows increases the accounting profit.

The cost of capital method for the fair value risk margin added to the technical reserves in Solvency II and the Swiss Solvency Test uses the cost of capital minus the risk-free rate.[44] Using the cost of capital method for the IFRS 17 risk adjustment for non-financial risk uses the cost of capital to value the profitability of the insurance contracts.

Confidence level vs cost of capital method

We compare the confidence level approach and the cost of capital approach to compute the risk adjustment for non-financial risk with respect to

A. the change in the risk adjustment over time
B. the accretion of interest on the risk adjustment
C. the relation of the risk adjustment to the risk aversion of the insurer
D. the effect of diversification on the risk adjustment

Part A: The cost of capital risk adjustment is the present value of the future cost of holding capital to support the insurance claims. Capital is held each year from initial recognition of the insurance contracts to the date the claims are settled. As the time since initial recognition progresses, the remaining period that capital is held becomes shorter, and the risk adjustment declines.

The uncertainty about the future claim payment is highest at initial recognition, before the claim occurs. The uncertainty declines as time progresses: claims occur, are settled, and paid, so the risk adjustment declines.[45] For life insurance death benefits, uncertainty is greatest at initial recognition, when future mortality improvement or mortality increases may change the future cash flows, and it is (mostly) eliminated when the claim occurs. For casualty insurance claims, the uncertainty decreases when the claim occurs but is not eliminated until the claim is settled.

The confidence level approach compares actual claim payments to the previous estimates. For life insurance death benefits, actual mortality is compared to expected mortality; for liability insurance, actual claim costs are compared to expected claim costs.

Actuaries track claim values by age: initial estimate (time t=0), after one year (time t=1), and so forth until the claim is settled. For claims settled at time t=n, the distribution of the ratios of the ultimate payment to the estimate at earlier times shows the uncertainty in the claim estimates.

Illustration: For claims settled at time t=3, the distribution of the ratios of ultimate claim payments to estimates at time t=0, 1, or 2 shows a high volatility (standard deviation) at time t=0, a lower volatility at time t=1, and the lowest volatility at time t=2. For a given confidence level that the supporting capital is sufficient even in adverse scenarios to pay the claim, more capital is needed at time t=0 and less capital is needed at time t=2.

For casualty insurance, the claim volatility is derived from the distribution of the loss development factors, which are the ratios of the ultimate payments for a block of claims to the estimates at earlier times.

As a heuristic illustration, suppose the loss development factors (using present values) for a block of general insurance claims from 12 months of maturity to ultimate for accident years 20X0 – 20X9 are {1.606; 1.671; 1.349; 1.516; 1.464; 1.575; 1.573; 1.353; 1.324; 1.455}. The standard deviation of this sample of ten factors is 0.120. If the loss development factors are normally distributed and the insurer holds no risk adjustment for non-financial risk, the probability that the fulfilment cash flows (accumulated for interest) will cover the ultimate claim payments is 50%. The cumulative distribution function of the standard normal distribution at X = 1.282 is 90%, so for a confidence level of 90%, the risk adjustment for non-financial risk must be 1.282 × 0.12 = 0.154 of the fulfilment cash flows. In practice, the loss development factors are not normally distributed and the sample of ten factors from a single insurer's experience is too small for credible estimates.

The uncertainty for life insurance claims depends on the variability in life expectancy, mortality improvement, and other influences on death benefits, such as epidemics, recessions, and lapses. At initial recognition of the insurance contracts, the future mortality improvement (and the other influences on death benefits) is highly uncertain, and the insurer may have a high risk adjustment for non-financial risk. As the actual experience on the contracts emerges, the uncertainty declines and the risk adjustment for non-financial risk decreases.

The uncertainty of the future claim payments varies by line of business. It is higher for general insurance than for whole life insurance three ways:[46]

- ! General insurance claims may or may not occur. Deaths eventually occur, and the death benefit in whole life insurance contracts will be paid (if the policy is still in force).
- ! The cost of the death benefit is stated in the life insurance contract. The cost of general insurance claims depends on the type of accident, the amount of litigation, and the court award.
- ! Life insurance death benefits are paid soon after the insured event (the death). General insurance claim payments may occur years after the claim occurs.

Part B: The cost of capital approach is the present value of the cost of holding capital each year until the claim is paid, so interest is accreted on this cost each year. By the end of each year, the cost of holding capital for that year is paid to investors or to tax authorities.

	the risk adjustment for non-financial risk at the beginning of the year
+	the accretion of interest at the appropriate IFRS 17 discount rate
–	the release of the cost of holding capital during the year related to future claims
–	the release of the risk adjustment for non-financial risk for claims paid during the year
=	the risk adjustment for non-financial risk at the end of the year

The confidence level approach does not set the risk adjustment for non-financial risk as the present value of future cash flows. The risk adjustment any year is not the risk adjustment in the previous year increased for accretion of interest and reduced for the release of part of the risk adjustment. Rather, the risk adjustment decreases from year to year as some claims are paid and the uncertainty in future claim payments decreases.

For the confidence level approach, the entire decrease in the risk adjustment for non-financial risk is insurance service expense. For the cost of capital method, the decrease in the risk adjustment for non-financial risk is part insurance service expense and part insurance finance expense.[47]

Part C: For pricing insurance contracts, the cost of capital method is a fair value risk margin that is not related to the risk aversion of the insurer. The supporting capital is based on regulatory formulas or on the average capital held by the insurance industry for a given line of business and country. A fair value risk margin depends on the behavior of market participants, not on the risk aversion of any insurer.

More risk averse insurers may hold more capital to support the future claim payments, so the risk adjustment might be indirectly related to the insurer's risk aversion. But the capital held by specific insurers depends more on historical happenstance than on risk aversion. Successful insurers, risk averse or not, have earned profits in past years and generally hold more capital than unsuccessful insurers.

Insurance premiums depend on the risk aversion of consumers. Risk averse policyholders pay premiums that exceed the present value of the expected claims to eliminate the risk of large general insurance or health insurance claims or to avoid the large decreases in net income from death claims. If policyholders were not risk averse, insurance would not be sold. The price of insurance contracts depends on the demand curve of consumers, which depends on their risk aversion, and the supply curve of insurers, which depends on their costs. But the risk aversion of investors does not affect the prices of the assets in efficient markets, though it does affect the choice of assets held by the investor and the types of securities issued by firms. Similarly, the risk aversion of an insurer does not affect the price it charges for its insurance contracts, though it may affect the lines of business in which it competes.

The 2013 exposure draft of IFRS 4 by the FASB (Financial Accounting Standards Board) combined the risk adjustment for non-financial risk and the contractual service margin into a single fair value risk margin, based on market prices and market discount rates, not the subjective risk aversion of an individual insurer.[48]

Illustration: If the present value of all future cash flows (including an allocation of costs that are not directly attributable to the portfolio of insurance contracts) at a risk-free discount rate is 100 and the premium charged for the insurance contract is 120, the fair value risk margin is 120 – 100 = 20.

IFRS 17 separates the difference between the premium charged for the insurance contracts and the present value of future cash flows into the risk adjustment for non-financial risk and the contractual service margin.

- The risk adjustment for non-financial risk compensates the insurer for assuming uncertainty in the future cash flows, and it is recognized as insurance revenue in profit or loss as the uncertainty is eliminated.
- The contractual service margin is the unearned profit in the insurance contracts, and it is recognized as insurance revenue in profit or loss as the insurance services are provided.

Part D: The confidence level is often measured by the value at risk, which depends on the diversification of the insurer. The loss distribution for diversified insurers is more compact than for less diversified insurers, with a lower likelihood of extreme losses, so the risk adjustment for non-financial risk decreases if the insurer is more diversified.[49]

Regulatory capital requirements, such as Solvency II, depend on the diversification of the insurer, so a cost of capital risk adjustment based on the regulatory capital requirement for a specific insurer depends on the diversification of the insurer. The average capital held by the insurance industry for a given line of business and country does not depend on the diversification of the insurer holding the risk adjustment, which would not be related to the insurer's diversification. A fair value risk margin based on the market price for the insurance contracts is independent of the characteristics of the firm holding the risk margin, including its diversification.

End-notes:

[1] See IFRS 17 paragraph IN6(d)(i), which says that an insurer "recognises and measures groups of insurance contracts at a risk-adjusted present value of the future cash flows," and IFRS 17 Appendix A, "Defined terms," which says that the fulfilment cash flows include a risk adjustment for non-financial risk.

[2] See IFRS 17 Appendix A, Defined terms: "financial risk [is] the risk of a possible future change in one or more of a specified interest rate, financial instrument price, commodity price, currency 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 a party to the contract."

[3] See IFRS 17 *Basis for Conclusions* paragraph BC215: "The risk adjustment for non-financial risk relies on an entity's own perception of its degree of risk aversion, rather than on a market participant's perception. This could result in entities determining different risk adjustments for non-financial risk for similar groups of insurance contracts."

[4] If the payments to policyholders depend on the expected return from a specified pool of assets, IFRS 17 uses the phrase "groups of insurance contracts for which changes in assumptions that relate to financial risk have a substantial effect on the amounts paid to policyholders." If the payments to policyholders do not depend on the expected return from a specified pool of assets, IFRS 17 uses the phrase "nominal cash flows that do not vary based on the returns on any underlying items."

[5] See IFRS 17 paragraph B86: "Financial risk is included in the estimates of the future cash flows or the discount rate used to adjust the cash flows."

[6] See IFRS 17 paragraph 106(a)(i) and (ii): "an entity shall disclose an analysis of the insurance revenue recognised in the period comprising (a) the amounts relating to the changes in the liability for remaining coverage … disclosing (i) the insurance service expenses incurred during the period … and (ii) the change in the risk adjustment for non-financial risk …," and B124(a) and (b): "insurance revenue for the period can also be analysed as the total of the changes in the liability for remaining coverage in the period that relates

to services for which the entity expects to receive consideration. Those changes are: (a) insurance service expenses incurred in the period … and (b) the change in the risk adjustment for non-financial risk …"

[7] See IFRS 17 *Basis for Conclusions* paragraph BC212: "IFRS 17 requires entities to consider the risk adjustment for non-financial risk separately from the adjustment for the time value of money and financial risks. The Board observed that some previous accounting models combined these two adjustments by using discount rates adjusted for non-financial risk. However, the Board concluded that combining the two adjustments is inappropriate unless the risk is directly proportional to both the amount of the liability and the remaining time to maturity. Insurance contract liabilities often do not have these characteristics. For example, the average risk in a group of claims liabilities may rise over time because more complex claims incurred may take longer to resolve. Similarly, lapse risk may affect cash inflows more than it affects cash outflows. A single risk-adjusted discount rate is unlikely to capture such differences in risk. The Board therefore decided to require a separate risk adjustment for non-financial risk."

[8] See IFRS 17 paragraph 81: "An entity is not required to disaggregate the change in the risk adjustment for non-financial risk between the insurance service result and insurance finance income or expenses. If an entity does not make such a disaggregation, it shall include the entire change in the risk adjustment for non-financial risk as part of the insurance service result."

[9] The IFRS 17 risk adjustment for non-financial risk is summarized in Bulpitt et al. (2017), Koetsier (2018), Hannibal (2018; 2019), and the IFRS Transition Resource Group (2018). The Canadian Institute of Actuaries (2018) compares the IFRS 17 risk adjustment for non-financial risk with similar Canadian Institute of Actuaries Standards of Practice. EIOPA (European Insurance and Occupational Pensions Authority) (2018) compares the IFRS 17 risk adjustment for non-financial risk with similar Solvency II requirements.

[10] See IFRS 17 paragraph 117: "An entity shall disclose the confidence level used to determine the risk adjustment for non-financial risk. If the entity uses a technique other than the confidence level technique for determining the risk adjustment for non-financial risk, it shall disclose the technique used and the confidence level corresponding to the results of that technique." See also IFRS 17 *Basis for Conclusions*, paragraph BC215: "to allow users of financial statements to understand how the entity-specific assessment of risk aversion might differ from entity to entity, IFRS 17 requires entities to disclose the confidence level to which the risk adjustment for non-financial risk corresponds."

[11] See IFRS 17 paragraph 104: "An entity shall separately disclose in the reconciliations required in paragraph 101 each of the following amounts related to insurance services, if applicable:

(a) changes that relate to future service … showing separately:
    (i) changes in estimates that adjust the contractual service margin;
    (ii) changes in estimates that do not adjust the contractual service margin, ie losses on groups of onerous contracts and reversals of such losses; …
(b) changes that relate to current service, ie: …
    (ii) the change in the risk adjustment for non-financial risk that does not relate to future service or past service; …
(c) changes that relate to past service, ie changes in fulfilment cash flows relating to incurred claims …]

We explain the three sections of paragraph 104:

- Paragraph 104(a): changes in both the present value of future cash flows (but not from the time value of money or changes in assumptions relating to financial risk) and the risk adjustment for non-financial risk that relate to future service and are offset by changes in the contractual service margin do not affect the insurance contract liability, and the part of these changes that is not offset by changes in the contractual service margin are reported as insurance service expenses in profit or loss.
- Paragraph 104(b): the release of the risk adjustment for non-financial risk for claims that occur during the reporting period is reported as insurance revenue if the insurance contracts are not onerous and as a

reversal of the loss recognized at initial recognition or in previous periods for onerous contracts.

! Paragraph 104(c): changes in the risk adjustment for non-financial risk for claims that have already occurred are reported as insurance service expenses under the liability for incurred claims.

[12] See IFRS 17 Appendix A, defined terms. See also IFRS 17 paragraph 37: "An entity shall adjust the estimate of the present value of the future cash flows to reflect the compensation that the entity requires for bearing the uncertainty about the amount and timing of the cash flows that arises from non-financial risk." See also IFRS 17 paragraph B86: "The risk adjustment for non-financial risk relates to risk arising from insurance contracts other than financial risk. … The risks covered by the risk adjustment for non-financial risk are insurance risk and other non-financial risks such as lapse risk and expense risk."

[13] See Merton [1973]; Fama and French [1996; 1997; 2004; 2006]. Some asset pricing models are based on the risk aversion of highly-diversified investors, who are assumed to prefer steady income to stochastic returns. These models relate the risk adjustment for an asset or liability to the covariance of the asset or liability with overall returns from financial assets.

[14] See Biger and Kahane [1978]; Fairley [1979]; Hill [1979]; Cummins and Harrington [1985; 1988]; Kozik [1994; 2001].

[15] See also IFRS 17 *Basis for Conclusions* paragraph BC19(c) and paragraph BC208.

[16] IFRS 17 does not say that the risk adjustment for non-financial risk increases the market price of the insurance contracts. Rather, it says that the risk adjustment for non-financial risk is the higher cost that the insurer would be willing to pay for the insurance claims. The relation of IFRS 17 to modern financial theory or to free-market economic theory is unclear.

[17] See Wang [1996; 2000; 2002]; Wang, Young, and Panjer [1997]; Muermann [2008].

[18] Modern financial theory assumes that investors are more concerned with the adequacy and the competitiveness of the insurer's pricing than with the risk aversion of the insurer. Diversified investors are not concerned with the risk aversion of the firms in which they invest, since they more efficiently eliminate risks by their investment strategy.

[19] See Brealey, Myers, and Marcus [2012]; Smith [2004]; Bickel [2006].

[20] The risk aversion of a firm often reflects the wish of senior executives to protect their positions, not the risk aversion of the corporate entity. See Jensen and Meckling [1976]; Jensen [1986; 2005]; Ang, Cole, and Lin [2000]; Fama [1980]; Eisenhardt [1989].

[21] IFRS 17, *Basis for Conclusions*, paragraph BC213(a), says that "limiting the number of risk adjustment techniques would conflict with the Board's desire to set principle-based IFRS Standards. In particular situations, some techniques may be more applicable, or may be easier to implement, and it would not be practicable for an IFRS Standard to specify in detail every situation in which particular techniques would be appropriate. Furthermore, techniques may evolve over time. Specifying particular techniques might prevent an entity from improving its techniques." IFRS 17, *Basis for Conclusions*, paragraph BC213(b), explains that specifying a technique for calculating the risk adjustment for non-financial risk would contradict the objective of quantifying the insurer's particular risk aversion, which may depend on other influences: "the objective of the risk adjustment for non-financial risk is to reflect the entity's perception of the economic burden of its non-financial risks. Specifying a level of aggregation for determining the risk adjustment for non-financial risk that was inconsistent with the entity's view of the burden of non-financial risk would contradict the objective of reflecting the entity's perception in the risk adjustment for non-financial risk."

[22] The terms may vary. A 99% value at risk or a 99% confidence level is often denoted as a 1% significance level.

[23] Although the Swiss Solvency Test and Solvency II tail value at risk or value at risk for the regulatory capital requirement, they use the cost of capital method for the risk margin added to the technical reserves; see the discussion of the cost of capital method further below in this chapter.

[24] See Stephanou and Mendoza (2005); Greuning and Brajovic (2009), section 10.4; Jiménez-Martín, McAleer, and Pérez-Amaral (2009); Munniksma (2006); Basel Committee (2013); Chang, et al. (2016); Basel Committee on Banking Supervision (2013).

[25] On value at risk, see Jorion (2001; 2002; 2007); Abad, Benito, and López (2014); Duffie and Pan (1997); Saunders and Allen (2010); Alexander and Sarabia (2012); Alexander (2009); Rockafellar and Uryasev (2000; 2002); Hendricks (1996); Jackson, Maude, and Perraudin (1998); Lopez (1999); Linsmeier and Pearson (1996; 2000).

[26] On tail value at risk, see Embrechts (1999); Embrechts, Kluppelberg, and Mikosch (1997); Artzner, et al. (1999); Artzner (1999); Artzner, Delbaen, and Koch-Medina (2009); Artzner, et al. (1997).

[27] Asset pricing models used in modern financial theory, such as the Capital Asset Pricing Model, consider the risk aversion of diversified investors, whom IFRS 17 refers to as market participants. In contrast, the IFRS 17 risk adjustment for non-financial risk depends on the risk aversion of the specific insurer, not the risk aversion of market participants. See IFRS 17 *Basis for Conclusions* paragraph BC209(a): "… a risk adjustment for non-financial risk should not represent the compensation that a market participant would require for bearing the non-financial risk that is associated with the contract. … the measurement model is not intended to measure the current exit value or fair value, which reflects the transfer of the liability to a market participant. Consequently, the risk adjustment for non-financial risk should be determined as the amount of compensation that the entity – not a market participant – would require."

[28] For a uniform distribution of claim values, the 1-P% tail value at risk equals the 1-½P% value at risk, so the 99% tail value at risk equals the 99.5% value at risk. As the (positive) skewness of the claim distribution increases, the 1-P% tail value at risk increases more than the 1-½P% value at risk increases. For a normal distribution, the 99% tail value at risk is about equal to the 99.6% value at risk.

[29] See Hendricks (1996); Jackson, Maude, and Perraudin (1998).

[30] See Saunders and Allen (2010).

[31] Non-European insurers do not have Solvency II capital requirements, but they have similar regulatory capital requirements in their home countries. Non-European insurers may also estimate theoretical capital requirements using the Solvency Capital Requirement formula of Solvency II.

[32] IFRS 17 *Basis for Conclusions* paragraph BC210(d) notes that "developing systems to determine risk adjustments for non-financial risk will involve cost, and some stakeholders doubt whether the benefits of such systems will be sufficient to justify that cost."

[33] IFRS 17, *Basis for Conclusions*, paragraph BC217 says: "The Board also considered whether … the cost of capital approach should be used as the basis for comparison. Although the usefulness of the confidence level technique diminishes when the probability distribution is not statistically normal, which is often the case for insurance contracts, the cost of capital approach would be more complicated to calculate than would the confidence level disclosure. Also, the confidence level technique has the benefit of being relatively easy to communicate to users of financial statements and relatively easy to understand. The Board expects that many entities will have the information necessary to apply the cost of capital technique because that information will be required to comply with local regulatory requirements. However, the Board decided not to impose the more

onerous requirements on entities when a simpler approach would be sufficient." Which method (cost of capital or confidence level) is easier to understand or easier to calculate is debatable. Solvency II and the Swiss Solvency Test use the cost of capital method because it gives the fair value (the market value) of the risk margin. The IFRS statement of financial position should give unbiased estimates of fair value when the information is available, not entity-specific estimates. Many insurers may use the cost of capital method for the IFRS 17 risk adjustment since they use it for Solvency II and for internal pricing. The illustrations here use the cost of capital method, which is often used to measure fair value and may be widely used by insurers subject to Solvency II or the Swiss Solvency Test.

[34] CAPM betas of 0.85-0.95 for property-casualty insurers and 0.95-1.05 for life insurers are sometimes assumed. But the data are sparse: most insurers are privately owned firms or mutual insurers, not publicly traded stock insurers.

[35] Some economists consider also the difference between personal tax rates on bonds vs the tax rate on shareholder dividends; see Miller (1977).

[36] Similarly, for the fair value risk margin in Switzerland, the supporting capital is the required capital from the Swiss Solvency Test.

[37] See Wirch and Hardy (1999); Wüthrich, Embrechts, and Tsanakas (2011).

[38] As a rule of thumb, some insurers estimate supporting capital as twice the required regulatory capital.

[39] On the capital estimates in ORSA reports, see Chief Risk Officers (2012); EIOPA (2011A; 2011B); Munich Re (2009).

[40] The capital held by the average insurer is about twice the required capital from statutory capital requirements, though this figure differs by country, by line of business, and by type of insurance contract.

[41] In practice, corporate taxes are generally paid quarterly in advance, not annually in arrears. The assumption here of payments at the end of the year is for simplicity only.

[42] The IFRS 17 fulfilment cash flows differ from the net present value of the insurance contracts by the treatment of certain expenses as well. Acquisition cash flows that are directly attributable to the portfolio of insurance contracts are included in the fulfilment cash flows. Other acquisition costs are written off as expenses when they occur and are not included in the fulfilment cash flows. The fulfilment cash flows might not include all the expenses for the insurance contracts and may over-state their profitability.

[43] For single-premium policies, the entire premium is often received up-front. For annual-pay policies, the premiums are generally level whereas the claim costs increase over time, so the average premium is received before the average claim is paid.

[44] The risk adjustment for non-financial risk derived by the cost of capital method uses the opportunity cost of capital minus the *after-tax investment yield*, for which the risk-free rate is an approximation.

[45] See IFRS 17 paragraph B91(e): "to the extent that emerging experience reduces uncertainty about the amount and timing of cash flows, risk adjustments for non-financial risk will decrease and vice versa."

[46] See IFRS 17, *Basis for Conclusions*, paragraph BC187: "non-life insurance contracts are more uncertain than life insurance contracts with respect to:

(a) whether the insured event will occur, whereas the insured event in some life insurance contracts is certain to occur unless the policy lapses;
(b) the amount of the future payment that would be required if an insured event occurs, whereas the future

payment obligation is generally specified in, or readily determinable from, a life insurance contract; and (c) the timing of any future payments required when the insured event occurs, whereas the timing of future payments in a life insurance contract is typically more predictable."

[47] The dis-aggregation of the change in the risk adjustment for non-financial risk between insurance service expense and insurance finance expense is an accounting policy choice by the insurer. IFRS 17 does not specifically relate the dis-aggregation to the method for estimating the risk adjustment for non-financial risk. The text here explains when a change in the risk adjustment for non-financial risk is logically insurance service expense or insurance finance expense.

[48] In contrast, IFRS 17 distinguishes the risk adjustment for non-financial risk for insurance contracts from fair value risk margins. See IFRS 17 *Basis for Conclusions* paragraph BC215: "An important difference between IFRS 17 and IFRS 13 is that the risk adjustment for non-financial risk in IFRS 17 relies on an entity's own perception of its degree of risk aversion, rather than on a market participant's perception. This could result in entities determining different risk adjustments for non-financial risk for similar groups of insurance contracts."

[49] See IFRS 17, paragraph B88: "the risk adjustment for non-financial risk reflects the degree of diversification benefit the entity includes when determining the compensation it requires for bearing that risk," IFRS 17 paragraph B91(c): "risks with a wider probability distribution will result in higher risk adjustments for non-financial risk than risks with a narrower distribution," and IFRS 17, *Basis for Conclusions* paragraph BC214: "the risk adjustment for non-financial risk reflects any diversification benefit the entity considers when determining the amount of compensation it requires for bearing that uncertainty."