

**IAA PAPER**  
**INSURANCE LIABILITIES – VALUATION & CAPITAL**  
**REQUIREMENTS**  
**GENERAL OVERVIEW OF A POSSIBLE APPROACH**

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## **Introduction**

The objective of this paper to present a general overview of a possible approach for the valuation of insurance liabilities and the capital requirements required as a consequence of the risk transfer from a policyholder to the insurer.

The paper begins with a brief explanation of the issue of fair value accounting for insurance liabilities. Since risks and risk assessment are the cornerstone of the insurance business, it is appropriate that they form an underlying context for the valuation process and methodologies used for general purpose accounting for insurance liabilities.

Subsequently, the risk-based valuation of insurance liabilities is extended to the calculation of capital requirements for an insurer through a risk-based capital model. The result is that valuation of insurance liabilities and capital requirements are integrated with general-purpose accounting

### **1 Fair Value Accounting and Risks Associated with Insurance Contracts**

In general, an insurance contract is one that contains an agreement by the insurer to provide, in exchange for insurance premiums, benefits to a beneficiary of the contract upon occurrence of specified uncertain future events affecting the life or property of the insured party. In essence, an insurance contract is a transfer of risk from the policyholder to the insurer.

A central issue in valuation and accounting is what do we mean by “fair value”? The IASC’s definition is:

“Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable willing parties in an arm’s length transaction.”

Unfortunately the fair value of a liability that is not actively or efficiently traded is not readily ascertainable through a financial market. This is in contrast to publicly traded assets such as bonds and stocks. However various approaches can be taken to determine estimates of such values based on discounted cash flow (DCF) techniques. Such techniques are also used to determine the fair value of assets either explicitly or implicitly.

There is generally no efficient market for most insurance liabilities. Actual prices that are observed for these liabilities are usually not appropriate fair values since they reflect the particular characteristics of the buyer and seller. In addition, most transactions are focused on shareholder value (e.g., franchise value and other intangibles) as part of an investment decision, and not specifically on the fair value of liabilities. Consequently, alternative measures are needed to determine the fair value of an insurance contract

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The timing and size of cash flows associated with the liability for an insurance contract typically involves both uncertainty and a long time horizon. The expertise of an actuary includes the assessment of the relatively complicated expected values of these liabilities, incorporating the various risks and embedded options involved. The following discussion represents an actuarial perspective of the fair valuation of insurance liabilities.

As mentioned above, an insurance contract involves the transfer of risk from the policyholder to the insurer. Insurance risks can be classified into the three main groups:

*1. The willingness or ability of the party to continue to pay the premiums*

The continued willingness to pay premiums is reflected in the risk of cancellation, lapse, or paid-up options available prior to the end of the contract term. This reduces or cancels the insurer's obligations in line with a decline in premium. The existence of surrender values may result in cash outflows - the timing, but not necessarily the amounts of which, is determined at the option of the owner of the contract. The payment of insurance premiums depends on (1) contract conditions, such as "being alive" and "not being disabled", (2) the willingness or financial ability to pay ("being solvent" status of the policyholder or risk subject) or (3) the resolution of disputes over the contract conditions or fairness.

Note that a policyholder pays a price if his surrender option is exercised. This price is that he is no longer able to access the insurance pool in which homogeneous risks are pooled according to the "law of large numbers". Thus in order to remain within the insurance pool and receive the benefits of being within the pool, the policyholder must continue to pay premiums at each renewal date.

In some cases, contracts may be subject to insurer cancellation or non-renewal. This may provide an opportunity for the insurer to avoid future risks.

*2. The uncertainty with respect to the timing and size of the benefits to be provided*

The timing of the benefits to be provided by the insurer depends on the terms specified in the contract conditions, and in addition the nature of the covered claim settlement process for general insurance. Events covered may include death (e.g., term insurance), survival to a maturity date (e.g., pure endowment), survival during the covered period (e.g., annuity), becoming and remaining disabled (e.g., waiver of premium or workers compensation), or suffering an accident (e.g., property damage), or being sued for negligence (e.g., liability).

In some cases, the benefit level also depends on the timing of the event (e.g., non-level or indexed insurance protection). And further the amount of the benefit level variation can be a significant risk, particularly for some general insurance contracts.

Due to the long-term or non-level nature of the obligations or the probability of loss over the course of the exposure period, the premiums may contain a savings portion; an element intended to be retained from early premiums in order to supplement the expected inadequacies of later premiums. This arises as a result of level premiums for policies with increasing risk and for policies where benefits are paid upon survival of the insured (e.g., a lump sum benefit at a maturity date and annuities). For several

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types of products, a minimum investment return on the savings portion of premiums is guaranteed. General insurance policies have an analogous savings feature to the extent that the eventual claim payment is expected to be well after the date premium is paid. In addition to these guarantees, policyholders often have the right to a form of profit sharing. The profit-sharing levels affect the overall performance of the company, and consequently affect its ability to remain competitive in the future.

3. *The risks related to the service provided by the insurer*

This category of risk relates to the expense level of the company (the actual realization of the expenses incurred), as well as to expense allowances in the product (both in premium loads and in interest spreads). The actual level of the expenses is not only a matter of efficiently running the business, but is also affected by external factors such as inflation.

Common features for all types of insurance include the existence of guarantees as to either the premium rates and / or the benefits during the contract term. For traditional insurance contracts, these are reflected in the benefit levels. For certain recently introduced types of life insurance or annuity products, the guarantees may not be related to the benefit levels themselves, but rather to methodologies for funding and investing the premiums.

A special feature of many life, disability and health insurance contracts is their relatively long-term nature. General insurance may be long-term with respect to delays in claim notification and the duration of the run-off of any associated claims, especially in the case of liability coverages, though normally the guaranteed coverage periods for most of these products tend to be relatively short. The dependency of general insurance benefits on the claim settlement process, and such factors as repair costs, court decisions, inflation, etc., increases the modeling complexity of any projected claim payments.

Many of the risks associated with insurance liabilities are highly correlated. For example, investment returns may influence future benefits through crediting rates, which at the same time create a competitive (disadvantage) advantage, influencing lapses on existing business and sales levels of future new business, which in turn affect the insurer's expense risk.

## **2 Valuation and Capital Requirements on a Risk-adjusted Basis**

### **2.1 Introduction**

Before considering issues relating to valuation and capital requirements on a risk-adjusted basis it is worthwhile to recall two concepts included in the IASC's Framework.

- The objective of financial statements is to provide information about the financial position, performance and changes in financial position of an enterprise that is useful to a wide range of users in making economic decisions. The Steering Committee

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notes that financial statements are not intended to present directly the value of enterprise as a whole, although financial statements contain some of the information that users need to make such a valuation.

- Information is relevant for the decision-making needs of users when it helps them to evaluate past, present or future events or confirm, or correct, their past evaluations. For example, information about an enterprise's current financial position, past performance, and cash flows has value to users in evaluating the enterprise's ability to generate cash and cash equivalents in the future.

In this context it is clear that a number of significant issues arise in establishing methodologies for the calculation of the fair value of insurance liabilities and the capital requirements for insurance business, including the following:

- The nature of insurance is to provide benefits. This suggests that the starting point for the financial reporting should be the valuation of the liabilities, and not the valuation of assets or shareholder's worth.
- The valuation of insurance liabilities should reflect insurance contract features and the specific risks of these contracts, including any embedded options or guarantees.
- Due to the long-term nature of many of these contracts and what, in the premium, often represents a significant savings element that forms part of the risk transferred from policyholder to the company, insurance companies have extensive asset portfolios covering these liabilities.
- In addition to the provision for insurance liabilities, an insurer holds capital as a solvency margin that provides assurance regarding the ability of the insurer to meet its obligations. The solvency margin can be used to measure the resilience of the insurer to withstand adverse developments. The development of accounting standards for the valuation of insurance liabilities is therefore closely connected to the methods employed to calculate solvency margins. By adopting the same risk-adjusted basis both for valuation and for setting capital requirements, it is possible to integrate regulatory liability and solvency requirements with general-purpose accounting.

The essential valuation principle outlined in this paper is that we first measure all the expected cash flows, including all options, future benefits, profit sharing / bonuses and expenses. These cash flows are uncertain with respect to the timing and the amount to be paid. Consequently there is a need to risk-adjust the valuation process. Here the cash flows are risk-adjusted reflecting the market perception of risk. The next principle is that we recognize that the business of an insurer is selling benefits that give rise to a set of obligations, recognized through its liabilities. The cash flows arising from the liabilities would be discounted based on these cash flows and not on other cash flows, for example the cash flows of an unmatched asset portfolio.

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## **2.2 Fair value liabilities – risk-adjusted valuation**

An approach to determining the “fair value” of insurance liabilities will now be described, taking into consideration the risks associated with insurance contracts and the valuation of assets (appropriate and available) that cover these liabilities in an equivalent and consistent way. The approach is presented as a possible methodology to reflect fair value accounting. In several respects, it incorporates many of the propositions mentioned above. Following this, a method for determining capital requirements (economic capital) consistent with the valuation approach is presented.

It should be noted that the fair value of insurance liabilities could also be calculated using indirect methods. Ideally both approaches should produce the same results if they follow consistent principles of calculation. Essentially the direct approach explicitly recognizes each risk type in the projected cash flows, whereas the indirect approach recognizes risk by discounting expected cash flows with a risk-adjusted discount rate. Using such an aggregate risk adjustment assumes the risk premium is proportional with the net cash flow including required solvency despite the various risks of the underlying cash flows have different incidence and profile.

A portfolio of insurance liabilities can be marked-to-model by creating a matching portfolio and discounting the liability cash flows at the asset yield of the matched portfolio. This is consistent with the valuation of assets that are not publicly traded or that are infrequently traded, where a model is needed to simulate a market value. For instance, a private loan can be marked-to-model by discounting all its expected cash flows at its applicable yield rates, after making allowance for the risk of default. Other types of assets may require more complex modeling.

The matching portfolio is defined here as the “replicating” portfolio and is the set of assets whose cash flows match the liability cash flows as closely as possible, given the assets available in the market. This portfolio essentially matches the liabilities in such a way that changes in market prices (e.g., interest rates) affect the changes in fair values of the liabilities and the fair value of assets (the replicating asset portfolio) in as parallel a fashion as possible. That matching should also reflect the interaction between policyholder behavior and market returns; for example, changing crediting rates on life insurance products create a competitive (dis) advantage, influencing the level of policyholder terminations on existing business and sales levels of future new business, which in turn influences the expense recovery risk.

If there is no active market, the valuation of a liability based on DCF techniques might be perceived to reflect subjective assessments. However, a concern should not arise as long as the valuation is based on a disciplined approach and rigorous development of assumptions. The liability value can be estimated by discounting the projected value of all applicable future cash flows. The fair value of the liabilities should represent the

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amount of money that would have to be transferred in order for a willing third party to take over the obligations that give rise to the liabilities.

To project the future expected cash flows of insurance contracts when determining the fair value of the liabilities, estimates for each source of the cash flows have to be made (e.g., mortality, morbidity, expenses, and claim frequencies and sizes). If the underlying parameters of the expected value of the cash flows could be determined with 100 % certainty (as in the case of the distribution function of flipping a coin) and the parties involved are risk-neutral, then the “expected value” would equal the market price. However in practice, uncertainty will exist with regard to the various parameters, and potential buyers and sellers will not be risk-neutral. The uncertainty includes but is not limited to the appropriateness of models selected, the distribution functions used in the valuation, future development of selected assumptions and process risk. Therefore, the fair value of the liabilities will not equal the “expected value of the liability”, but rather the expected value plus a reward for the risk. This reward is defined here as the “Market Value Margin” (MVM).

In the context of the IASC Insurance Issues Paper, the expected value is equivalent to the “expected value” as discussed in sub-issue 6F paragraph 227. The MVM is consistent with IASC’s concept of the “premium included by the marketplace for bearing the uncertainty inherent in estimated future cash flows”, sub-issue 11H paragraphs 613 and 619. Hence, the MVM is not a prudent margin in the normal actuarial sense, but rather a margin demanded by the market in recognition that the cash flows are not risk free.

The market premium for risk, the price for uncertainty, is by definition independent of the company. However, the MVMs for a particular company reflect the market’s perception of the risk within that company and hence include the characteristics of the business. As such, the MVM is derived from the market’s view of a risk within the company and the premium for that risk charged by the market. The IAA view on which assumptions (expected value and MVM) are to use is addressed more specifically in the IAA response to sub-issues 6C and 6D and the IAA paper “MARKET EXPECTATIONS REGARDING EXPERIENCE ASSUMPTIONS” commenting on sub-issue 6D.

In principle, the MVMs for a given portfolio of contracts are a function of the risk-aversity of the market. If the market were to become more risk-averse while the actual risks remain the same, the MVMs would increase. It is, however, very difficult to separate the effect of a more risk-averse market from an outright increase in risk itself. A practical alternative for “instantaneous” market values, as described above, is to use a consistent approach to setting risk margins.

In summary, MVMs have the following properties:

- They represent the uncertainty of each assumption on which the liability is based.

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- They are added to expected value of the liabilities to obtain the fair value of liabilities.
- They reflect appropriate portions of the uncertainty in the various parameters used to calculate the liabilities.
- The appropriate level of the MVM is independent of the company currently holding the liability, since it is a “market” judgment of the uncertainty of future cash flows.

The calculation of MVMs may require relatively complex models that use stochastic projections and risk-neutral decision rules. Such models are being used in many financial institutions to model “value-at-risk” and the probability of ruin. In particular, option valuation models are expected to be a useful starting point for the determination of MVMs. Appendix A includes some further discussion on the MVMs and a separate IAA discussion paper on “risk adjustment” that deals specifically with many of the issues involved with the calculation of MVMs.

An advantage of using MVMs in the liability valuation and the subsequent calculation of economic capital is that it is possible to model both the liability valuation and capital requirements within a common and consistent methodology (see section 3.1).

Finally, it is important to already recognize that setting MVMs will require some guideline-driven judgment on the part of actuaries and guidance from the appropriate actuarial organization, such as the IAA (based on applicable IASs). Similar to any valuation methodology that relies on projection and discounting of expected values including risk adjustments, the selection of assumptions and methodology will require continuous review to determine the appropriateness and relevance of the assumptions and methodology.

### **2.3 Valuation of cash flows**

In theory and often in practice a direct approach can be used to determine the discounted value of expected cash flows. This would involve the derivation of a risk-free zero-coupon rate discount rate from the forward rate swap markets (not necessarily of government securities). The swap market is very liquid in many jurisdictions, which makes it possible to discount cash flows, even those with a 50-year time horizon.

Nonetheless, investment markets where insurance companies operate are often neither fully developed nor complete, and in addition, it is often not possible to project accurately the expected value of all the embedded options in the liabilities. Hence another approach to the valuation of the liability expected cash flows is using risk-neutral valuation principles and the replicating portfolio. Here the liability cash flows (including the MVMs) will be discounted at the rate of return on assets with cash flows matching them – this is the replicating asset portfolio. If these “risk-corrected” liability cash flows could be matched perfectly to a set of assets generating the same cash flows, then movements in

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values of assets and liabilities arising from changes in interest rates would be identical. This implies that the liability cash flows should be discounted at the yield on the matched assets, and that these matched assets should be chosen to be as risk-free as possible, (since the liability cash flows are risk adjusted by including the MVMs). Consequently, in the case of perfect asset/liability matching there is no effect on the financial statements as a result of interest rate movements.

Consequently, the liability cash flows will be discounted with the rate of return(s) of the replicating portfolio. When it is not possible to create an investment portfolio from existing investments with cash flows that completely match the adjusted liability cash flows, a portfolio has to be chosen that matches the adjusted liability cash flows as closely as possible, using the assets available in the market. This mismatch is another source of risk for the insurer. More details on constructing the replicating portfolio can be found in a separate IAA paper “VALUATION OF RISK-ADJUSTED CASH FLOWS AND THE SETTING OF DISCOUNT RATES – THEORY AND PRACTICE”, commenting on sub-issue 11G.

*Remark: The aforementioned mismatch risk is the result of either the complexity of the product design or the lack of available assets in the market. This mismatch risk cannot be avoided by a “willing buyer” and hence is to be reflected in the fair value of liabilities. In addition there can be a further mismatch risk when the actual assets held by the insurer differ from the replicating portfolio. This voluntary mismatch risk can be avoided by a “willing buyer” and hence will not be reflected in the fair value of liabilities but is to be reflected in the capital the insurer is required to be held.*

#### **2.4      Emergence of earnings**

Some fear exists that under a fair value accounting system profits will become more volatile for multi-period contracts. This, however, will largely depend on a company’s asset-liability strategy and on how consistently the parameters underlying the valuation can be estimated over time. Volatility will arise as a result of new business sales, an asset-liability mismatch position, realizations deviating from expectations, reserve basis changes and return on surplus.

Essentially, in the approach as given in this paper, profit emerges in accordance with “release from risk”

- Profit will be realized at point of sale as long as it is *certain* (given the risks) that these profits will materialize in the future. Profitable new business will have a positive P&L impact in the year the business is sold. Similarly, expected losses are immediately reflected in the P&L as well. Under many regulatory accounting systems, new business sales will lead to up-front losses whether the business is profitable or not.

Both fair value and traditional accounting systems can result in volatile results as the level of new business sales varies. However, fair value seems to give a truer reflection of

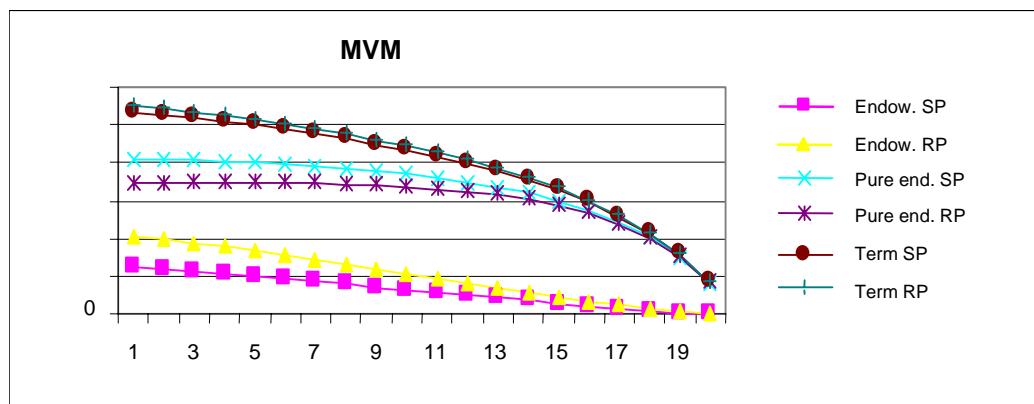
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the value of business: more sales lead to larger losses under traditional accounting, but to more profit (given that the business written is profitable) under fair value accounting. Alternatively, a slow-down in sales leads to higher profits under traditional accounting and smaller profits under fair value.

- If, in later years, no deviations from expected values occur and assets are well matched to the liabilities, the annual profit will equal the release of the MVM; this release will be in line with the decrease in corresponding risk. Both deviations from the expected values and changes in liability assumptions immediately flow through the bottom-line P&L.
- Provisions for liabilities are set up to spread earnings over time; any reserve deficiency will eventually hit bottom-line profit. Under most traditional accounting systems these losses will either show up gradually over time if reserves are not immediately increased, or shock-wise if suddenly additional provisions are set up. Fair values will immediately reflect all future losses, and will prevent large unexpected increases in provisions by requiring continuous reviewing of the underlying assumptions, and incorporating new knowledge.
- If perfectly matched, changes in interest rates will impact assets and liabilities to the same extent. Similarly, the larger the mismatch, the more volatile the P&L will become as a result of changes in market rates, reflecting the risk the company runs. These risks are also present in non-fair value accounting systems. However, accounting approaches that use historical prices largely ignore these risks.
- Finally, the return on surplus will immediately impact the bottom-line profit, as would be the case in all other accounting systems, unless this return would immediately be charged to surplus.

The following is an example of the MVM-release over time resulting from uncertainty risk with regard to mortality rates. The graph shows the development in the MVM for a group of 45-year old males for different types of insurance coverage, all with a remaining term of 20 years, (SP – single premium, RP – regular premium):



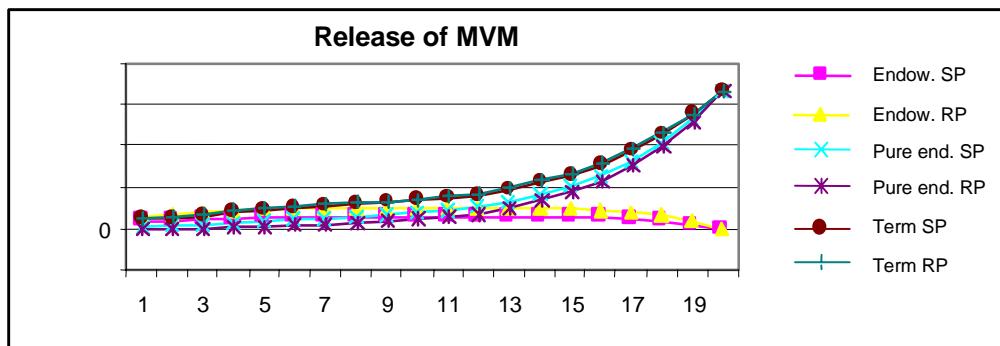
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The release of the MVM (in line with the release of risk) can be defined by the following formula, assuming that expected values come true:

$$release_t = MVM_{t-1} * (1 + i_t) - MVM_t$$

Where  $i_t$  equals the investment return on the replicating portfolio, or graphically:



The above graph clearly shows that the release of the mortality MVM is consistent with the mortality risk transferred by the policyholder to the insurer, and how this risk changes over time for specific insurance contracts.

Finally, the use of a deferred acquisition asset in a traditional balance sheet represents deferred expenses minus amounts already amortized. Historically such an asset has been used to re-structure the reporting of earnings so that expenses match revenues, in a deferral and matching approach. Current FASB statements on insurance accounting reflect this opinion. Since fair value accounting is based on projected liability cash flows, the present value of future acquisition expense loads is already recognized when calculating the liability. Therefore, there is no need to record such an asset. This is similar to what happens under Margin-on-Services reporting currently used in Australia.

### 3 Economic Capital (Risk-adjusted Capital requirements)

#### 3.1 Introduction

The variability in the cash flows affects a company's profit over time and more importantly during a specific reporting period. Therefore, a company needs a certain level of capital, which, with a certain level of confidence, prevents it from becoming insolvent. Worldwide, different definitions and measurement tools are now used to measure this required capital. The level of conservatism included in technical reserves in various countries also affects the level of required capital in excess of these technical reserves.

In the aggregate, the capital required covers both the risks for the policyholders that the company cannot meet its obligations and the risks for the investors in the company that

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they will lose their investment. In many cases, the greater of regulatory or market capital is currently considered to be a company's required capital and by default its economic capital.

In this paper, “economic capital” is measured on a risk-adjusted basis. The capital is needed to protect against a change in value of the business, such that the likelihood of default, undesired impairment, or insolvency of the company over a given time horizon is less than a specified confidence level. This confidence level is set either by the regulators or the market in such a way as to be consistent with the level of comfort (risk-aversion) required by these institutions. As regulators usually require more prudence, the comfort levels of regulators might differ from that of investors. However, the use of similar methodologies in the evaluation and analysis of the risks of the company would make comparisons possible.

In the following section, a brief presentation is given of an approach consistent with the risk-adjusted valuation approach described in the previous section of this discussion paper.

### **3.2 Default risk**

An insurer's default risk in essence defines a level of (dis) comfort for both the policyholders and the investors in the financial condition of an insurance company or as implicitly included in a claims paying rating. Both categories of stakeholders share a similar objective, i.e., that the company be able to pay the contractually agreed benefits and to return the amounts funded by the investors, respectively. However, this similarity of objectives does not necessarily imply that both groups require the same level of confidence.

The investor's view may be reflected in the company's debt rating as measured by rating institutions. This debt rating is the market perception of the company's ability not to default. Rating institutions set debt ratings as a function of the company's expected default rate based on the company's perceived or inherent risks in relation to the amount of capital held.

The view of the policyholder is often measured in relation to capital requirements set by regulators. Worldwide, various methodologies and techniques are used to develop capital requirements. For example, the NAIC (the U.S.'s National Association of Insurance Commissioners) and OSFI (the Canadian Office of the Superintendent of Financial Institutions) have adopted risk-based capital approaches in which risks related both to assets held and to liabilities are reflected. Basically, the European Union expresses its capital requirements in terms of either the amount of insurance provisions or premium volume. Since some of the regulatory requirements are based on historic experience and are expressed in a simplified form, it is not always clear what risks are taken into account and, more importantly, what probability of ruin the requirements are meant to protect.

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This paper takes the position that the calculation of economic capital should be based on expected ruin probabilities or default rates, taking into account all the risks to which the company is subject. Ruin probability does not only imply the odds of a bet but also the size, further such probability needs to take into account infrequent events such as epidemics, earthquakes and severe storms.

Risk can be defined as the deviations of the fair value of assets and liabilities between expectations and realizations relating to the different factors that affect the value of its cash flows. We consider only the downward deviation in the fair value difference between assets and liabilities when analyzing required capital levels. The sources of these deviations are:

- The “uncertainty” (arising with respect to the current experience as well as the future experience) with respect to assumptions setting in general (model selection, parameters and distributions) and
- The fluctuations around the fair value generally referred to as “volatility” or statistical fluctuations.

Given that value is defined as the discounted value of expected future cash flows, for economic capital purposes we need to consider possible events occurring over the chosen time interval that affect either the cash flows in that time period, or expected cash flows in future time periods. That is, the impact of the variability of the cash flows relative to expected values plus MVM determines the level of economic capital.

By measuring the impact of the variability in cash flows in this way the calculation of the economic capital is consistent with the valuation approach given earlier in this paper. In total, the economic capital needs to be sufficient to absorb all adverse deviations or scenarios with a very high degree of certainty, say, 99.95% of the time -- a non-default solvency target.

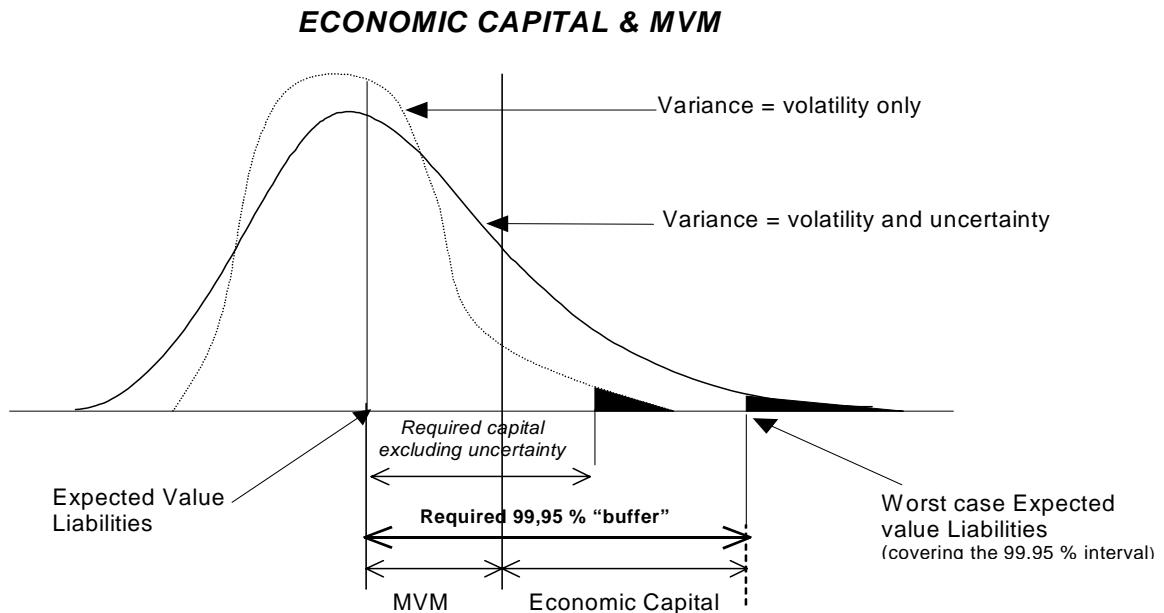
A potential problem exists when available data is incomplete; especially as a 99.95% non-default solvency target implies working far out in the tail of statistical distributions. Events included in such a tail should be for instance occurrences like the “black plague”, although the information with regard to that disaster will be far from perfect.

The portion of the risks that has not been included in the fair value of liabilities (and assets) is taken into account in the calculation of economic capital. This reflects uncertainties in the model and process risk, setting assumptions, uncertainties with respect to the distribution functions of the risk factors, and the volatility in the risks.

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The following picture provides further insight into this approach:



The various risks included in or associated with insurance contracts or the assets backing the liabilities may be quite different in nature. While similar in objective, the tools required to measure and to analyze them, not only are different, but also need to be supplemented with a decomposition of risk into the various (sub)-risk types to make it measurable, transparent and manageable. Therefore a categorization and separate analysis of risk types is needed. There is no unique classification for risk, and depending on the purpose of the classification the level of detail and separation for any risk type can be extensive. In this discussion paper eight risk types have been selected. Obviously other risk structure classifications can be used when determining the fair value of liabilities and capital required. The purpose should be that any codification of risk types supports a well-structured and transparent calculation in the determination of the liabilities and capital.

#### *Risk types*

There are eight major risk types considered below. Under each of major types further subdivision is often necessary and desirable in order to present a complete understanding of the risks inherent in the business.

- Credit risk
- Transfer risk
- Market risk
- Business risk

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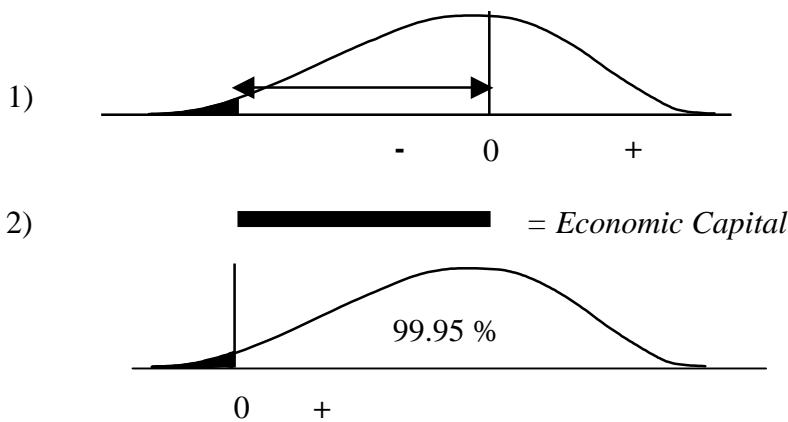
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- Operational risk
- Mortality risk
- Morbidity risk
- Property and casualty risk

This division of risk types is one of the possible ways to classify types of risks. Its advantage is that it is consistent with classifications used by other types of financial institutions. By using a similar split, methodologies and tools developed for these institutions to measure economic capital among these institutions can be comparable. A brief description of each of the risk types is included in appendix B.

### 3.3 Determination of capital required for each risk type

To determine the capital required for each risk type, the net change in the fair value of assets minus fair value of liabilities must be assessed separately, resulting in a statistical distribution of the net change in fair values. The required amount is then determined as follows: (for a company using a 0.05% default probability, expressed in the following graphs as a “left-tail” risk).



- 1) In this example the expected impact (expected value + MVM) on the net profit is zero.
- 2) The “economic capital” that should be held at year-end  $t$  should be high enough that the amount of funds available (expected value + MVM + economic capital) is sufficient with a 99.95% probability.

The methodologies for measuring the impact of the risks can be quite similar for all the risk types. The first step is to consider the sources of deviations separately, i.e., (1) the uncertainty with respect to assumption setting in general (parameters and distributions) and (2) the fluctuations around the fair value, generally referred to as volatility. It is possible to combine both uncertainty and volatility in one model, but especially for long-

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term business, the analysis and modeling require separate analysis in order to be more manageable and understandable. The analysis may need to include scenario testing to reflect the impact of low frequency and large severity events as these normally cannot be appropriately quantified from available data.

The next step is to separate, where possible, frequency, timing, amounts and correlations among risks. The separate study of these elements also provides the advantage of enhancing the understanding of the sources of deviations from their expected values. The amounts reflected indicate both the size of the exposure (the amount covered in an insurance contract or a loan) and its severity.

The uncertainty risk can be measured in terms of the uncertainty in the estimated trend in expected rates of occurrence. Note that many years of data may be needed to evaluate this risk properly. Shifts in historical experience data need to be monitored and analyzed closely (to identify, for example in mortality rates, the *shocks* resulting from enhanced and increased use of medical technology).

The measurement of volatility risk requires the development of probabilistic models. As this part of risk analysis excludes uncertainty in the estimation of the parameters of the model distribution function, the parameters can be assumed to be constant. Two possible approaches to measure the volatility risk are (1) an empirical approach where the historic data relative to the expected is considered, and (2) an analytical approach, in which a probability distribution is assumed. Note it can be important to measure volatility risk for both the frequency and the severity of an event.

These methodologies all require extensive data on risk events, scenario and simulation techniques. Each risk type needs its own specific assessment.

Generally, the methodologies used are not company specific. For some of the risk types, such as credit risk, worldwide data are available for measurement and analysis of the risks, although company-specific underwriting is part of the risk exposure and should be taken into account. As mentioned earlier in this discussion paper, the banking business has already developed (or has made progress in the development of) a number of methodologies and tools to measure and analyze risk types such as credit risk, transfer risk, market risk, business risk and operational risk. Some of these tools can be applied in the insurance business, though some adjustments will be needed, particularly as a result of the long-term nature of most insurance risk, different types of guarantees and embedded options.

The methodologies for the calculation of economic capital need to reflect the long-term nature of the insurance business. The assumptions to be used for a time horizon are given by the minimum period over which the company can re-capitalize to any new required capital level. Alternatively, the time horizon can be expressed in terms of the minimum period over which the company can be expected to close outstanding risk positions, either

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by selling them, by buying hedges in the form of derivatives (market risk and credit risk) or through reinsurance. In some situations it might not be possible to close outstanding risk positions and the company is forced run-off the liability exposure, such as an existing mass tort exposure for asbestos or hazardous waste.

The long-term nature of an insurance contract is reflected in:

- Benefits or guarantees in the future as specified in the contract conditions
- Payment of future premiums

It is important to note that the effect of events during the time horizon is projected beyond the horizon period. This means that if, for example, an event (or shock) during the time horizon period increases mortality rates, one has to analyze whether this higher level also needs to be taken into account after the time horizon period.

If re-capitalization were assumed to be possible after one year, one approach would be to measure the change in net present value of all future cash flows over an annual time frame to the specific confidence interval. This implies a projection of the future effects of the impact on the existing business of all simulated events in the one-year time horizon period.

31 May 2000

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**Appendix A: Fair Value of Insurance Liabilities**  
**The concepts of expected values, MVMs, volatility and uncertainty**

In general, the complexity of modeling future cash flows is greater for insurance liabilities than for many other financial instruments because of the specific structure of the liability cash flows: very long term guarantees, dependent on premiums yet to be paid.

Ideally, insurance cash flows should be modeled and valued using option-pricing theory (at least for the “hedgeable factors” like interest rate guarantees). This theory implies that the market value of a financial security product producing uncertain cash flows is the same as the cost of hedging this uncertainty. However, this equivalence only holds in efficient markets (meaning that the uncertain factors can be traded in liquid and deep financial markets). Besides this, the “uncertainty factors” are highly interdependent (for instance, interest rates affect crediting rates and hence policyholder behavior) which makes the modeling of the uncertain cash flows extremely complex.

Therefore, a simplification typically is needed and so an estimate will be made of the parameters of the probability distributions for each factor.

Three key elements of the assumptions are:

- Expected value(s) of each assumption used when determining the expected values (reflecting expected changes from the past);
- Uncertainty with respect to the choice of the model, process, the type of distribution itself and/or the right parameters for distribution; and
- Volatility of the assumptions (as is reflected by the standard deviation).

The first will be included in the calculation of the cash flows.

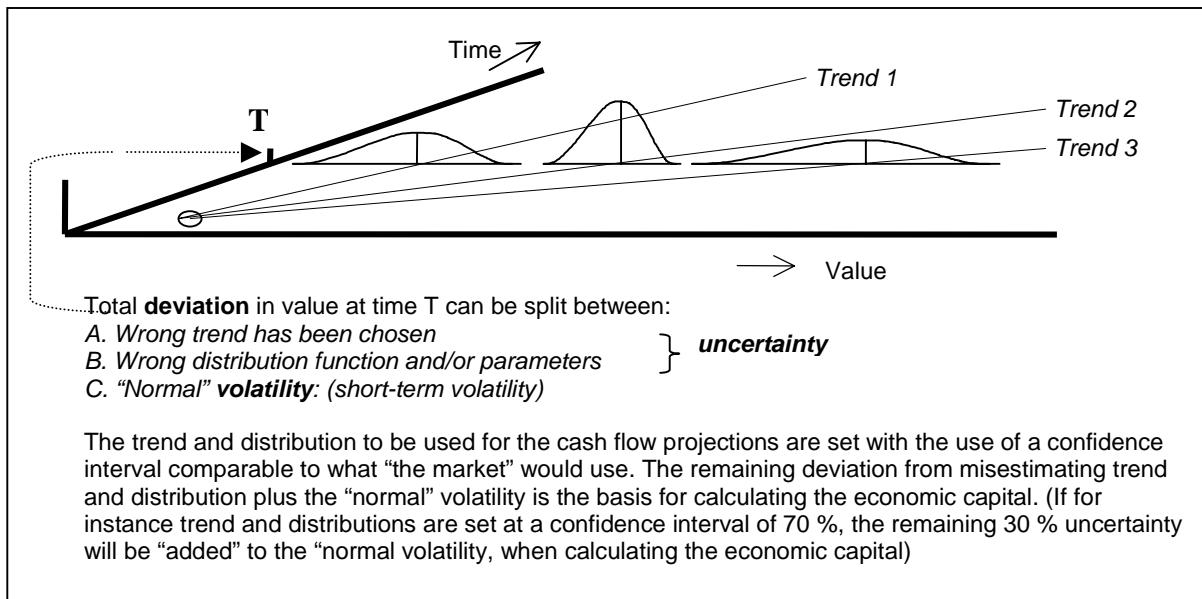
The second forms the basis for the “Market Value Margin”. There are three aspects to the uncertainty with which the MVM is meant to deal. The first is the wrong model is chosen. The second is the risk that the expected values have been misestimated in the first place. The third is the risk that the expected values will change over time as actual experience deviates from expected.

The third, the volatility of the assumptions, can form the basis of determining needed economic capital calculations. Associated with this volatility is the risk that actual future experience will fluctuate around the expected value. This risk should be covered by economic capital and should not be anticipated in the liabilities.

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Economic capital is the outcome of the resilience the company has to withstand adverse developments and hence covers both volatility and uncertainty risks up to the required level. If the MVM's lower confidence levels are used, the remaining part of the uncertainty risk is included in the economic capital. As such, there is an inter-relationship between the three key elements, expected values, MVMs and economic capital.



The assumptions used in estimating the future cash flows are set as expected values used when determining the expected values plus a Market Value Margin. The MVM reflects uncertainty with respect to the models, parameters and distribution functions chosen. It is desirable to determine a theoretical basis for the MVM. Although in the following some additional remarks as to the basis for MVM are given, this derivation is outside the scope of this general overview paper.

The MVM is not a prudent margin in the normal actuarial sense, but simply a margin demanded by the market in recognition that the cash flows are not risk free. The difficulty is to estimate this MVM. Some possibilities include:

- Assign a confidence interval that the market implicitly uses. It also might be possible to assign a utility function to the market, and use it consistently for valuing risky cash flows. This would have the advantage of taking into account the full distribution, rather than a somewhat arbitrary dividing point.
- Use the assumptions applied in pricing (adjusted periodically based on actual results), assuming that these also include some margin for adverse deviations. The advantage of this approach is that the price the company is charging to its clients is a market price.

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It has been noted that, when blocks of policies are traded, the margin demanded by the market is of the order of one, to one and one half, times the standard deviation of the probability distribution involved. One practical and straightforward way of applying this is to define a narrow range of arithmetic adjustments, derived from dynamic analysis of the probability distributions of the assumptions. These adjustments would be applied to the expected value assumptions and would be incorporated in a set of standards of practice. In the latter context it would be essential that the range of available adjustments is narrow and that it is monitored regularly to ensure its continued appropriateness.

It must be noted that the risk adjustments in respect of specific contingencies may be either additive or subtractive relative to the expected value of the contingency. However, the MVM always acts to increase the liability. For example, for benefits payable upon death of insured lives (as in term insurance), the mortality MVM is applied in a manner to increase future mortality rates, whereas for benefits payable upon survival of covered lives (as in life annuity contracts), the mortality MVM is applied in a manner to decrease future mortality rates.

Finally, it must be recognized that in applying risk margins to individual contingencies, the aggregate result must be reviewed for reasonableness and adjusted where necessary. Usually, within an insurer, or even within a portfolio of similar insurance contracts, there will be offsetting mitigating risks. As a result, the aggregation of specific risk margins for each contingency may overstate the risk margin demanded by the market and so an appropriate adjustment is required. This suggests that, even when risk margins are applied individually to contingencies, some aggregate dynamic analysis is advisable to avoid this overstatement.

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## **Appendix B: Risk Type Classification**

As mentioned previously there is no unique classification for the various risk types. Any risk classification structure will reflect the purpose and reasons why “risk” is being codified. Obviously other risk structure classifications can be used when determining the fair value of liabilities. Under each of main types further subdivision is often necessary and desirable in order to present a complete understanding of the risks inherent in the business.

### **1. Credit risk**

Credit risk is defined as the risk of default and change in the credit quality of issuers of securities (in the investment portfolio), counter-parties (e.g. on reinsurance contracts, derivative contracts or deposits given) and intermediaries, to whom the company has an exposure.

#### *Credit risk versus Market risk*

The credit or default risk due to changes in the credit quality of the fixed income assets held, normally referred to as issuer risk, can be classified in two ways: as credit risk or as market risk. One approach is to treat this type of risk separately from those that are clearly market risks (e.g., interest rate risk), with issuer risk handled through credit risk methodology. If it is practical to treat this risk in an integrated way with the other market risks (e.g., through variance-covariance methodologies based on the underlying prices of the assets which include both outright market and credit spread risk), then issuer risk will be handled by use of market risk methodology. For the credit risks in an investment portfolio, an approach integrated with market risk is normally more appropriate and preferred.

### **2. Transfer risk**

Transfer Risk (sometimes referred to as sovereign or a type of political risk) can be split into two categories:

- Translation risk: capital deployed by the parent company in overseas operations that cannot be repatriated when required. If operating or book capital is supplied to a business unit and converted to another currency (e.g., the local currency of the business unit), then long term or translation foreign exchange risk is created.
- Solvent foreign clients or counter-parties may be unable to meet their obligations due to an inability to obtain the convertible currency needed as a result of government restrictions/regulations (e.g., the liquidity crisis in Russia in August 1998). Note that in this case the economic health of a counter-party is not by definition affected.

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**3. Market risk**

Market risk is that part of investment risk that, in principle, could be hedged. The part that cannot be hedged at all constitutes a part of business risk (see below). Investment risk is defined as volatility of the net value (fair value of assets minus fair value of liabilities) due to changes in interest rates, equity prices, real estate prices, foreign exchange rates or other factors.

**4. Business risk**

Business risk is the exposure to loss of value due to changes in the volume and mix of new business and the run-off of existing business, and due to the guarantees created by the product designs that cannot be matched by investments. It is the risk of being “in-business”.

“Unhedgeable mismatch risk” is classified as a business risk, since it is inherent to the sale of particular type of insurance product (given the assets available in the market).

**5. Operational risk**

Operational risk is the risk associated with one-off events such as fraud, systems failure, litigation, regulatory breach, etc. By its very nature, operational risk capital is difficult to quantify, since it is driven by infrequent events of high severity, and can be significantly mitigated or exacerbated by the quality of internal controls and guidelines.

**6. Mortality risk**

Mortality risk is defined as “the risk exclusively associated with being a life insurer”. This risk is especially a result of deviations in timing and amount of the cash flows due to the (non-) incidence of death.

Mortality risk occurs both in businesses where costs increase as mortality increases (by age, such as endowments and term assurances) and those where costs increase as mortality decreases (such as annuity portfolios). The latter risk is also sometimes referred to as longevity risk, to distinguish it from the life risk associated with protection products, whose characteristics are very different (annuity holders are typically older, and are affected by different illnesses / causes of death than those that affect younger protection product customers).

**7. Morbidity risk**

The definition of this risk is similar to that of mortality risk and hence is defined as a result of deviations in timing and amount of the cash flows due to the (non-) incidence of disability and sickness. The risk of incidence of morbidity (disability) relates to both premium cash flows (as a result of an attached rider for waiver of

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premiums) as well as the cash outflows (disability benefits and insured health care expenses).

#### **8. Property and casualty (P&C) risk**

P&C risk is the risk associated with being a P&C insurer. These risks are principally due to the claims paid varying in size, number, or timing of benefit payments. The variation has many causes but include uncertainty in respect of future inflation and judicial decisions. One particular concern for a P&C insurer is “moral hazard”; this is where the insured can influence both the frequency and size of the claim.

As with mortality and other forms of risk, P&C risk comprises both volatility risk and the “remaining” part of the uncertainty risk.