The Volatility in Long-Term Care Insurance

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Executive summary

The experience of many long-term care insurance (LTCi) policies has proven to be quite different than the assumptions made in the determination of their premiums. This difference has been driven by multiple factors, including a lack of statistical credibility and relevant experience available at that earlier time, subsequent changes in the nature and operation of certain types of service providers, the liberalization of policy features, a mismatch between LTC insurer and insured incentives driven by certain policy features, unforeseen or underestimated risks relating to general population mortality, morbidity, policyholder behavior, and the investment environment. The overall uncertainty and changes in conditions external to LTC insurers have led in many cases to underpricing and under-reserving.

As a result of the risks and uncertainties associated with these dynamic conditions, this insurance product line has experienced a great amount of volatility, which has been challenging for LTCi stakeholders to interpret and act upon in a timely manner. It is thus important for stakeholders, including LTC insurers and their regulators, to enhance their assessment of underlying experience in a timely manner, made difficult because of the long-term (time between initial pricing and experience) nature and severely steep cost curves.

The objectives of this paper, commissioned by the Society of Actuaries, include an assessment of the basis of volatility of experience and financial results, considering the risks and uncertainties associated with long-term policies, especially LTCi. In so doing, it is observed that a properly determined provision for risk and uncertainty is needed in premiums and reserves. It then describes the approaches that can be taken to quantify such a provision in new and re-rated LTCi.

The paper discusses possible mitigation approaches that have and should be taken, especially but not limited to the use of policy design features to enhance the alignment of interests of the LTC insurer and its policyholders. It also explores the relationship between historical and expected future risks and uncertainties specific to LTCi. It concludes by pointing out the pervasiveness of the uncertainties involved, the earlier underestimation of the uncertainties involved, although the actual degree of uncertainty may have decreased over time as relevant experience has been obtained. Effective management of LTCi demands incorporation of mitigation approaches in its product design and continuous monitoring of relevant experience.

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Background

Current valuations of insurance of all kinds are based on probabilities of cash flows and their present values. These probabilities are usually[i] developed under the assumption that the distribution of expected future outcomes is known and their outcomes are reasonably well-behaved or whose time horizons are relatively short, even when measured in years.

In contrast, the distributions associated with very long-term insurance coverages, especially long-term care insurance (LTCi), can be particularly subject to uncertainty and subject to significant risks. Lack of experience, competitive pressure and failure to recognize the range of LTCi and economic (interest rate) outcomes in the early years of LTCi, a product first available in the 1970s, resulted in vulnerability to miss-pricing. This in turn has necessitated premium increases for many blocks of this business to cover promised benefits. In response, the Long-Term Care Insurance Model Act and Regulation of the National Association of Insurance Commissioners (NAIC) was amended in August of 2000 to protect consumers from rate increases.

Inevitably, experience for LTCi has and will continue to differ from expectations, not only because of random fluctuations and the lack of complete knowledge of the underlying probabilities, but the long time dimensions that apply and the dynamic nature of the environment affecting LTCi will undoubtedly affect this insurance coverage. Within the LTCi industry, some of these changes in conditions have led to experience that would have been difficult to predict. One example has been the relatively recent popularity of assisted living facilities (ALFs). With the availability of benefits for ALFs, policyholders have had increased willingness to seek care in these facilities as compared to nursing homes, which in turn has led to higher costs for insurers.

Indeed, because (1) future LTCi experience cannot be predicted with a great deal of confidence, especially over the distant future, and (2) claim data is usually limited for many years after policy issue due to relatively low claims experience for many years, experience will inevitably be volatile. The effect of this expected volatility should be reflected through a provision for risk and uncertainty (PR&U) in its premiums (and financial statements, if the applicable accounting standard permits one). A PR&U has also been referred to as a provision (or margin) for adverse deviation or as an adjustment for risk.

The objective of this paper is to explore the basis for, measurement of, and the effects of this volatility and uncertainty as it relates to LTCi. The quantification of these effects is outside the scope of this paper, although they are addressed in the paper "Understanding the volatility of experience and pricing assumptions in long-term care insurance" (Loomis et al. (2014)).

Although many of the concepts discussed in this paper also apply to other types of insurance, there are several features of LTCi that contribute to making it sufficiently different to suggest the need for a separate discussion. Its primary distinguishing elements include its long-term nature, its low level of claims in early policy durations and at younger ages, the dynamic nature of services and service providers covered, utilization of policyholder options, the subjective nature of benefit qualifying

conditions and the need for different underwriting for LTCi compared to life insurance. These increase the risk and uncertainty in the cost of covered services that are far removed from the inception of the LTCi policy, with early claim history that may or may not be indicative of future experience. Although the time between policy inception and the insured event is no longer than the corresponding contingent event for most life insurance, the combination of very high persistency rates, lack of established experience tables, lapse supported nature of this product (that is, no intermediate cash values), the steepness of the cost (service use) curve, and wide cost variation of its covered services, has made the volatility in its cost particularly significant and challenging to reflect.

This paper first discusses the concepts and categorizations of risk and uncertainty associated with volatility. It then describes alternative methods that have been used to quantify risk and uncertainty evidenced through volatility of experience and financial results through the use of a PR&U, as well as approaches to assess appropriate levels of volatility in the pricing of insurance coverages, including LTCi. It then discusses mitigation approaches that have and can be applied to reduce this volatility, focusing on applications to LTCi. Current regulatory and insurer expectations are that new LTCi premiums are set with a premium margin in order for premiums to be set at a level large enough to absorb costs over the life of the block of policies covered that is not worse than "moderately adverse" compared with that expected. This paper discusses the concepts underlying these expectations.

The Society of Actuaries commissioned this paper to partially satisfy its call for research on "Long-Term Care Insurance and Volatility". Key questions raised included:

› How risky is a typical LTCi block of business?

› How are these risks exacerbated by product design and how can they be mitigated by product design modifications?

› How can an actuary differentiate between poor experience due to inherent volatility in the underlying LTCi business and poor experience due to incorrect assumptions? What implications does this have for pricing margins and triggers for rate increases?

1. Risk and uncertainty

Insurance policies expose insurers to significant risks and uncertainties. This is recognized in the marketplace in many ways, manifested not only by means of margins included in the premiums charged for these policies, but also, if applicable, in the prices charged by a third party if the risks are transferred to that party, either through reinsurance, business combinations (i.e., mergers or acquisitions), or portfolio transfers.

Risks and uncertainties associated with LTCi policies arise as a result of many factors, including benefit eligibility triggers that are not as straight-forward as a death for life insurance, the complex benefit design of a LTCi policy, policyholder behavior with respect to use of covered services, and its long-term nature (benefits paid in an insured's 80s and 90s, originally purchased in that person's 40s and 50s). For example, coverage eligibility triggers have evolved from a medical necessity qualification (which is essentially equivalent to a doctor's determination) to a demonstration of the lack of ability to perform two or more activities of daily living (ADLs) or cognitive functions, which is a much more stringent criterion to meet.

As a concept related to dispersion, volatility is usually expressed in terms of observed variations (such as a standard deviation) around an expectation or historical value such as an average or trended average over a specified period of time. A significant challenge to an LTCi actuary is to assess experience information in order to determine how much reliance should be placed on these observations. To do so, experience should be de-composed if possible to help to distinguish the extent that volatility arises from risk or uncertainty. A significant part of the remainder of this paper deals with how to distinguish among and manage key sources of risks and uncertainties, including the effects of mitigation, and their incorporation in PR&Us in premiums.

To effectively provide insurance coverage to its policyholders, an insurer must identify and manage the risks and uncertainties associated with its insurance business. The volatility in the financial results of its insurer is a product of these risks and uncertainties. This is especially challenging in a product line such as LTCi with its low early claim rates over a very long coverage period in which the underlying forces are dynamic and inter-related. Interpreting deviations from expected is difficult enough, let alone determining whether these deviations will continue over the long-term life of the business. This long-term period makes it difficult to effectively operate the feedback loops that facilitate effective insurance risk management. This also impedes sound pricing practice of both new and re-rating of inforce business. Given the history of this product line, without effective mitigation tools, there would be even fewer LTC insurers than are currently active writing this business.

Although it is possible to describe a conceptual distinction between a PR&U in premiums that provides for the expected cost of volatility and for expected profit (in excess of the cost of volatility), it is usually difficult to identify the bright line distinction between them. Premiums incorporate the aggregate effect of bearing both risk and uncertainty, which reflect the overall expected sources of volatility representing an inherent reward for conducting an insurance business. "Excess profits" (present value of net expected cash flows derived from the contracts, including a PR&U), if achieved, would be over and

above the cost of bearing risk and uncertainty, a result of the imperfect LTCi market, a return on a level of capital that provides for a level of risk and uncertainty greater than moderately adverse. In reality there is no such thing as a perfectly competitive market (where, according to economic theory excess profits would be driven down to a minimal level). Arguably, because insurance policies, with few exceptions, have not been bought and sold in a perfect market, such profits can be assumed to exist, but are usually difficult to isolate and quantify.

Risk and uncertainty have been viewed and categorized in several ways, depending upon what is being analyzed and the application. The following sub-sections describe selected key characteristics of volatility with respect to LTCi:

1. **Risk and uncertainty**

    The modern distinction between economic risk and uncertainty was presented by the economist Frank Knight. In his 1921 book, *Risk, Uncertainty, and Profit*, he distinguished between situations under risk where the outcomes were unknown but governed by probability distributions known at the onset (such as tossing a fair coin), in contrast to uncertainty situations where the outcomes, although likewise random in nature, are governed by an unknown probability distribution or model. "The essential fact is that 'risk' means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomena depending on which of the two is really present and operating… It will appear that a measurable uncertainty, or 'risk' proper … is so far different from an unmeasurable one that it is not in effect an uncertainty at all."[ii] Knightian uncertainty is often referred to as "uncertainty" about the extent to which the expected mean of the probability distribution is incorrect.

    Knight's distinction has been used by some commentators to differentiate between measurability and unmeasurability, objective and subjective probabilities, and insurable and uninsurable probabilities of probabilistic outcomes. Knight went on by indicating that "'judgment', 'common sense', or 'intuition'"[iii] is used for business decision-making relating to those items that are "unmeasurable" through formal processes of logic and model-building. A more practical and useful distinction may be drawn between process risk and parameter risk that does not attempt to deal with whether uncertainty is measurable, as described in the "Methods of quantification of risk and uncertainty" section of this paper.

    According to Langlois and Cosgel (1993), LeRoy and Singell (1987) interpreted Knight as understanding that an agent can form subjective probability assessments of any situation, so that the distinction that Knight intended to make was between situations in which insurance markets can operate smoothly (risk) and situations in which insurance markets would become unsustainable because of moral hazard and adverse selection (and associated uncertainty and internal imbalances). LTCi has shown itself to be particularly vulnerable to adverse selection due to its high premiums and the generous benefit provisions with which it has sometimes been sold.

Except in unusual and laboratory situations (e.g., tossing a coin) that are rarely encountered in the real world, partial information or suppositions will always exist, and thus the expectations regarding future cash flows will in practice always be a combination of risk and uncertainty. In addition, since future conditions will always be at least partially different than those of the past, a distinction between objective/subjective probabilities is rarely distinguishable, and as a result judgment will always be needed.

Consistent with this distinction, Karl Popper noted that outcomes of physical experiments are produced by a set of "generating conditions". When an experiment is repeated, it is independent with a more or less similar set of generating conditions. Such generating conditions that have the propensity p of producing the outcome E means that those exact conditions, if repeated indefinitely, would produce an outcome sequence in which E occurs with limiting relative frequency p. However, this only occurs if future conditions are identical to those in an earlier experiment. Therefore, due to differing conditions, conclusions reached based on past events cannot be automatically assumed to be applicable in the future, because of the differing conditions.

Differences from a base set of expectations can emerge as a result of many factors, including (1) a lack of proper understanding of the underlying coverage or insureds and (2) changes in conditions, especially discontinuities in experience or performance, some of which are referred to as "black swans" (although often thought of as negative or adverse, they can also be beneficial in nature). The most obvious of these black swans are catastrophes, either of natural causes or man-made. Less obvious, but possibly representing an equal or greater likelihood and cumulative importance in long-term insurance policies such as LTCi than a one-time discontinuity in future experience, are significant but gradual differences in trend in one or more underlying factors. A "grey swan" event is something that could be anticipated, but is considered at the time to be unlikely to occur, but if it does, its effect is difficult to quantify. It is important to note that not all discontinuities in experience are due to swan-type sources—expected changes can manifest themselves quickly or are simply the result of statistical fluctuations either prior to or after the point of discontinuity.

In LTCi, both gradual (trend) and sudden (discontinuities) changes in conditions can be difficult to identify, predict, and distinguish from a process (statistical fluctuation) risk. LTCi examples of both types of changes are given in the "LTCi and Volatility" section of this paper. Examples of analogous changes include broader environmental changes as a result of a sudden advancement in medical technology or in social attitude toward LTCi benefit utilization, applicable regulation, and change in the nature of the services provided or service providers.

Donald Rumsfeld, a former U.S. Secretary of Defense, made a distinction[iv] between known knowns, known unknowns (grey swan), and unknown-unknown (black swan) risks. A distinction between the latter two categories of risk is between (1) sources of volatility inherent in past or current conditions, but not yet quantified or understood, and (2) those risks or sources of volatility that did

not exist in the past, such as a disease never before identified or a new LTC provider of what proves to be a compensable service that emerged after the valuation date.

The concept of "risk" as used in finance, at least with respect to short-term financial values, is primarily concerned with process risk (see below for a discussion of this concept). In most insurance situations however, the term risk is more associated with uncertainty, as many actuaries in their development of prices, products or financial reporting, are more concerned with processes that are long-term in nature and whose daily, weekly, or monthly fluctuations are not especially significant with respect to overall adequacy or appropriateness. As the time period observed lengthens, perceived process risk tends to decrease with the reduction in effect of short-term fluctuations. Nevertheless, both are of concern, because management, regulators, and investors need to make decisions based on an understanding of reported performance that reflects longer-term volatility and the value of future obligations of an insurer.

It is important to attempt to distinguish between the effects of risk and uncertainty. Methods that have been used to test for the existence of uncertainty have included:

- Statistical significance testing that determine whether observed differences in predicted experience are statistically significant.

- Confidence intervals that provide a measure of the limits within which the actual risk will lie with a certain degree of confidence. Where practical, use of the formula: variance (actual – expected) = variance (actual) – variance (expected) – 2 x covariance (actual, expected).

- Pervasiveness and consistency of differences between actual and expected experience. For example, if these differences arise in all significant categories (e.g., geographical regions, period of issue, risk classifications) it is more likely to be due to a period effect, although analysis may be needed to ensure it is not due to unrecognized changes in claims management or data coding.

- Smoothed results over time (using rolling periods of, say, one or three years, depending on the amount of experience) rather than monthly reporting periods that often contain a significant amount of statistical noise.

Because it can take significant time between the issuance of a group of LTCi policies and when the emergence of adverse experience can be definitively recognized, one of the major concerns with LTCi has been whether volatility, that is, divergence between actual and expected experience, is due to temporary (i.e., involving risk) or permanent (i.e., involving uncertainty) conditions expected to continue or to evolve that should be reflected in changes in premium rates. Analysis of emerging experience using these methodologies has the potential of being used to identify leading indicators of adverse experience, which could provide better criteria that could assist both insurers and State insurance regulators to evaluate rate increase requests.

2. **Process, parameter and model risks**

Classical North American actuarial decomposition of risk and uncertainty has been made into the following three categories:

a. **Process risk**

Process risk, sometimes referred to as statistical risk, is the risk of unavoidable random statistical fluctuations that occurs in any stochastic process. It will occur even if the insurer has chosen a model that is totally accurate and has accurately estimated the parameters of the distribution under that model.

Insurance risks often cover a large number of relatively homogeneous but independent risks. The aggregate process risk of a portfolio of insurance policies (measured on a per policy basis) can be reduced by increasing the number of policies in an insurance portfolio or the time period over which observations are made, since the process risk decreases as the square root of the number of policies exposed increases.

However, the extent to which pooling (that is, aggregating many policies) reduces insurance risk can be limited by not only the uncertainty regarding the true expected values and shapes of the applicable probability distributions, but also because of the uncertain relationship between factors that affect experience. For example, trends or discontinuities in the use and cost of types of providers potentially affect all insureds, but more likely only affect certain geographical regions in which the applicable providers are sited. At the same time, claim incidence can move in the same or opposite directions than claim continuance, depending on the drivers of the changes. For example, an increase in the rate of Alzheimer's disease can lead to an increase in LTCi claim incidence and average claim duration, while an improvement in active life mortality can lead to more insureds reaching older ages at which more long-term care services are needed.

One view is that it is inappropriate for a PR&U to reflect homogeneous and independent risks, because the risk and uncertainty involved could effectively be eliminated by insuring a sufficiently large number of insureds. This view is similar to the concept of not requiring a PR&U for diversifiable risk (see below). In spite of this, conditions under which LTCi operates are not sufficiently stable, nor are insurance markets sufficiently efficient, to eliminate the need for a PR&U for LTCi risks and uncertainties.

b. **Parameter risk**

Parameter risk arises because information about an underlying probability distribution is, by necessity, incomplete, with the resulting distribution being inadequate or incorrect. It is the risk

that the parameter estimates for the model are incorrect. It has also been referred to as measurement risk and is analogous to uncertainty described in the prior sub-section.

i. Estimation risk. Historical data represent necessarily incomplete information, since it is obtained from conditions different from the period for which the estimates will be applied to. However, most actuaries take a Bayesian approach with respect to the parameters used as input to their models; that is, they develop an initial set of assumptions that they modify as better experience and enhanced understanding are obtained, thus gradually reducing parameter risk. Generally, a set of observations constitute only one realization out of an infinite range of "might have been" scenarios. As a result, it is subject to random sampling error. Other reasons include inaccurately reported or otherwise available data, and variations between insurance risks that are not intuitively obvious until appropriately distinguished experience data becomes available.

ii. Exposure mix risk. Not only experience can change, but also the composition of insureds covered by LTCi may change or become different than what the pricing assumptions were based on. This risk can be due to different characteristics or behavior between cohorts or generations, different market segments from which insureds are drawn for an insurer, different choices made by insureds or insurers, or different underwriting rules or risk classification groupings applied. The cost of LTCi can be significantly affected by selection (due to the markets targeted and underwriting procedures followed) and anti-selection (on the part of those who apply for LTCi at the time of and after application), which in some cases have arisen from inadequate market penetration. These factors have led to a deviation of industry experience from that of the general population.

iii. The future will be different. Future experience will differ from that of the past, in part because future conditions will be different. Some of these changes arise due to a gradual or sudden change in conditions (of a temporary or permanent nature), which can be due to a paradigm shift, such as when legislative, business model, and social attitudes change. Examples of paradigm shifts that have arisen in the past have been when (1) the business model for assisted living facilities changed to encourage those who might be anticipated to have limited ability to perform certain activities of daily living, the incidence of claims for LTCi increased, and (2) society realized that second-hand smoke was dangerous, which resulted in changes in smoking prevalence and restrictions in locations where people could smoke. Both examples were unforeseen and not reflected in available experience as input to the basis of insurance premiums.

Other examples of changed conditions that have resulted in actual experience being different from that previously expected have included: greater policy persistency, lower interest rates, lower active life mortality rates, lower disabled life mortality and recovery rates as a result of a greater percentage of claims due to mental or cognitive conditions than anticipated, and greater claim incidence because of more use of ALFs and greater supply of

home health aides that in some cases more than offset overall population health improvements. Other possible examples of sources of uncertainties in the future include a cure for Alzheimer's disease, new government programs, delayed adverse effect of increased obesity prevalence, and changes in availability and willingness of family members to provide caregiving support.

c. Model risk

Models by definition are simplified representations of reality. Model risk arises when an incorrect representation of the future is used be it the proper parameters (variables) or the right model structure. This can arise from under- or over-specification of the variables (specification risk) used in the model. Under-specification occurs when a model is over-simplified, in an extreme example, mortality rates that are independent of age. Over-specification occurs when there is too much concern about fitting parameters to non-statistically credible or irrelevant data, incorrect variables are applied, over-extrapolation (e.g., linear extrapolation when not appropriate), or an incorrect underlying structure has been applied. Unless a pre-determined factor or formula-based model is used, uncertainty models can be quite complicated. Models should be subject to proper governance and controls. They should also be validated, and subjected to sensitivity and stress testing, where practical.

There is no single accepted model for this business, although adaptation and refinement should occur as more information and insight becomes available.

The time period observed can change the mix between process and parameter risk. For example, if reporting or experience is measured on a daily, weekly or even monthly basis, the volatility due to process risk for those short periods should be expected to dominate. The longer the period studied, the closer to "true" results should be expected to be observed, in which parameter risk will likely dominate. In addition, to study whether a trend is occurring may require an even longer observation period. One approach to determining whether a trend exists is to study experience on a rolling basis, which tends to smooth out the contribution of process risk to volatility.

Some believe that even though it is conceptually preferable to reflect parameter risk and model risk, it is not necessary to include an adjustment for the sources of these risks until persuasive evidence is available to enable an insurer to quantify their effects by reference to observable data. Nonetheless, as long as these risks are estimable, it is appropriate and indeed necessary to include them. In fact, not including a provision for parameter and model risks (i.e., only including a provision for process risk) is tantamount to unsound pricing by ignoring economic reality, which may lead to inappropriate business decisions (in the extreme case, capital or surplus inadequacy). Thus for LTCi pricing, it is appropriate to include a provision for process, parameter and model risks.

3. Diversifiable and non-diversifiable (or insurable and uninsurable) risks

Risks may also be characterized as being either diversifiable or non-diversifiable. For example, market risk for stocks can be diversified by aggregating stocks from different industry sectors, as in most cases they are all unlikely to move in the same direction. In fact, the risk of any stock has a diversifiable and a non-diversifiable (or systemic) component. The non-diversifiable component can be characterized by the trend line in the relationship between that stock and the market, representing risks shared with all elements in the market. The diversifiable component is the variation around that trend line. Similar analysis can be applied to each risk factor that affects an insurance premium.

There is a limit to the diversification benefit, beyond which the marginal benefit of risk reduction is smaller than the loss of potential returns. Some risk factors impact all insurance policies or stocks, as applicable, equally and are non-diversifiable. Factors unique to a particular stock are largely diversifiable. Most risk factors fall between these extremes.

Risks may be described as either market-based or independent of market (also known as "orthogonal"). In the context of investment risks, market risk can be understood by considering risky assets such as stocks. In capital asset pricing model (CAPM) terms, the return from each stock has a (positive or negative) correlation with the return from every other stock. The regression coefficient between the individual stock and the market is called the "beta" of the stock. Risks that are uncorrelated with a market are independent of that market and have a beta of zero, although if a stock is included in what is measured as "the market", it likely has at least some (albeit quite likely small) correlation to the market by virtue of its inclusion as part of the market.

Similar to the above capital market example, morbidity and mortality rates of individuals in a pool are usually considered independent of the corresponding rates of the others in the pools. They are, however, close to being independent, as they may be subject to similar environmental and provider conditions, as well as similar habitational attitudes and insurer claims management processes, some of which may be correlated to some extent to overall market or economic movements.

Regarding the investment risk in LTCi, there is also a mismatch risk: the risk that environmental conditions will affect investment and insurance performance to a different degree. In theory, investment risks (that include the risk that investment return will be different than assumed in or implied by today's market asset prices) can be reduced by asset-liability management techniques such as hedging, at least over a short and possibly intermediate future. However, there are limits to the effectiveness of such investment mitigation techniques, in part because there are no investments that exactly match the variations around the expected cash flows for LTCi risks in later policy durations. These variations can be very large. Reinsurance can provide a partial match, but they do not provide complete protection due to counterparty credit risk.

While some believe that diversifiable risk should not impact the amount of PR&U, others believe that since no market is perfect, all investors require some PR&U (risk premia) for all risks, whether diversifiable or non-diversifiable. Since insurance markets are not perfectly efficient and complete

diversification of LTCi risks is not practical, a PR&U would be correspondingly appropriate for all insurance risk. Market prices reflect both diversifiable and non-diversifiable risks as both types of risk are always present and can be estimated. Thus, both types of risk should be considered.

4. Hedgeable and non-hedgeable risks

The discussion so far has assumed that all relevant risks and uncertainties are reflected in the applicable risk distributions. For the purpose of a PR&U, risks reflected in the risk distribution include all of their non-hedgeable aspects. A risk is hedgeable if an active market exists in which the risk can be traded, such as via derivatives; hedgeability derives from the existence of a relevant market and not directly from the characteristics of the risk. Risks normally determined to be non-hedgeable, including those associated with the runoff of claims/satisfaction of policy obligations, such as the risk of variability in the amount of settlement obligations, reinsurer counter-party credit risk, and operational risks. Risks normally determined to be hedgeable may include market or credit risk of invested assets, to the extent they are hedgeable.

Risks that are not completely hedgeable are considered in PR&Us. For example, these also may include interest rate risk for very long durations or market and currency risk in thinly traded markets, such as those in developing economies.

Hedging risks is one example of the use of a risk mitigation technique. For a discussion of additional examples of these techniques, especially as they apply to LTCi, see the "Mitigation" section of this paper.

5. Multiple sources

The overall uncertainty associated with a single LTCi policy or portfolio of these policies arises from multiple sources. These sources may or may not be related and inter-dependent. The extent that these sources of risk and uncertainty are related creates dependency uncertainty. These sources are further discussed later in this paper.

The sources of risk and uncertainty include those that affect:

- Persistency of insureds to the time they need policy benefits. These factors include voluntary lapse and pre-claim mortality, which affect future premiums received and benefits payable.

- Utilization of eligible policy-reimbursable services during the coverage period. They include policy features, the physical and mental condition of insureds, attitudes toward types of long-term care services, the types of benefits provided, the availability of service providers, and insurer's claims management practices. These factors affect future claim incidence and claim continuation.

- The cost of policy services, limited by periodic or aggregate policy maxima. They include policy features, supply and demand of providers, and geographic areas. These factors affect benefit utilization rates.

- The ability of an insurer to provide sufficient funds to pay benefits. They include investment income, operating expenses, and financial resources. These factors affect allocated benefit payments, investment income, discount rates, and expenses.

6. **Time it takes risks to emerge**

LTCi policies provide for benefits over a very long period of time (e.g., they may be issued in an insured's 60s, with benefit payments in the insured's 90s). Consequently, additional sources of risk and uncertainty emerge and change over this period as the conditions affecting each of the sources of risk and uncertainty of LTCi changes. They can be manifested as either one-time shocks, one-time permanent changes, gradual trends, or uneven moments. These dynamic influences over time represent second order parameter risk. While over a short-term period their effects may not be significant, they may represent a significant source of uncertainty over a longer-term horizon. They thus "fatten" the probability tails involved.

Even without these dynamic changes, the forces affecting the sources of uncertainty may be time-dependent. In other words, certain gradual trends may continue over time, without necessarily reverting to an earlier expected mean, as might be expected for other economic variables.

Similarly, the ability for risk aversion is likely to increase over time, as more useful information is available. The effect of uncertainty over the future period might decrease. This has the same effect of gradually reducing the parameter uncertainty as more information is obtained and may reduce the uncertainty portion of a PR&U over time as a portfolio of policies ages.

7. **Risk concentration**

A high level of risk concentration exists when a large percentage of an insurer's risks (e.g., coverage, market segment, geographic area of insureds or assets, and asset types for example in a single industry) is in a certain category of exposures. For example, although the management of a mono-line insurer with only LTCi policies inforce can provide focused attention on and specialized expertise relating to LTCi, it can simultaneously suffer from a lack of diversification of risks.

Achievement of economies of scale (through greater business volumes) can enable spreading overhead or operating expenses over a larger number of units. However, it carries with it a potential increase in the aggregate effect of catastrophe and operational risks to the company, thereby at least somewhat offsetting the beneficial effect of risk diversification and risk pooling.

Large risk concentration can result in greater volatility, in part due to the potential for large catastrophic losses. Note that an adequate amount of capital and surplus may be able to absorb the effect of certain operational risks (events) or catastrophes with low probability and high severity, resulting in a larger degree of financial uncertainty than would be the case had there be less concentration. Nevertheless, the question of how to determine the degree of concentration or tail risk that would be significant enough to qualify as a catastrophe remains an issue for continuing study and debate.

The aggregate effect of concentration of risks is one example in which the expected experience of a group of insureds may not be independent and can be inter-related.

8. **Source of inputs**

To the extent that a perfect market is available, a calibration of the amount of risk and uncertainty can be performed with respect to market prices; however, such a deep and liquid market never seems to exist. Valuation techniques would need to be applied. The following types of margins reflect the source of inputs to the model applied. The risk criteria used are a function of statistical measures such as confidence intervals.

a. Market value margins (MVMs): This approach estimates the economic value of risk implied by market prices. A given degree of risk can have different values to different individuals, depending on the extent of their risk aversion. Prices of risk in the market reflect a consensus of the views of market participants.

   Of course, just because risk exists and market participants charge for the risks undertaken does not by itself mean that the resulting prices are necessarily "correct", as these are influenced by such factors as the current market risk aversion, misinformation, and herd mentality. For example, since the LTCi industry has been subject to adverse experience, a consensus of market participants might assume that the adverse experience or trends continue.

b. Provisions for risk and uncertainty (PR&Us): A PR&U provides for expected outcomes reflecting estimates of risk and uncertainty that are based on nonmarket based factors. This method assigns probability distributions to the risks undertaken and determines a PR&U based on those probability distributions, using confidence intervals or similar measures.

   The most relevant and reliable observable experience should be the basis for the experience assumptions. Under normal circumstances, the best source would be derived from policies and claims from the same product and insurer, for which experience is most relevant (i.e., including the same market segment, underwriting screens, policy features and claims management). However, in some cases, especially when LTCi is a new or immature line of business for an insurer, external data (e.g., aggregate insurance industry experience or general population data,

although caution needs to be applied if not adjusted to be consistent with the insurer's product features, underwriting, market segment, and effects of the existence of insurance) or professional judgment will be needed either as a substitute for or a supplement to the insurer's experience data.

The blend of experience used as input will depend on the amount of data with characteristics similar to the business being assessed or the reliance that can be placed on either external or other internal sources. For example, if LTCi is a new line of business with the insurer, no internal data would be available. Unadjusted industry data or public data without any selection or insurance-affected constraints may not be relevant to the business being studied.

The use of historical experience requires an understanding of the conditions under which that historical information was obtained and estimates of the expected effect of changes in those conditions. Historical experience is, at best, a sampling from the underlying actual experience, which is not known for certain.

3. Methods of quantification of risk and uncertainty

In different contexts, risk and uncertainty has been quantified in either the aggregate or separately for each valuation assumption. It has also been applied implicitly or as an explicit PR&U. Each approach has its advocates.

A PR&U can be based on either a bottom-up or top-down approach. A bottom-up approach quantifies a PR&U by determining appropriate provisions for each individual assumption and then reflecting the effect of their correlation, while a top-down approach evaluates total risk on an aggregate basis across all risk types and assumptions relative to best estimates. From a top-down perspective, an insurer's entire capital is available to support all of its risks with its overall capital a function of its total risk profile. From this point of view, the probability distribution that matters most is the probability distribution of total net claim costs, although assumption-specific probability distributions might be used to derive the aggregate distribution. Once the total PR&U is determined, an allocation of capital and the PR&Us are needed to determine the insurer's total premium or reserve needs.

The results from these two approaches can be equivalent, even though their derivation might be quite different. This section discusses the alternative approaches that could be taken.

Objectives and desirable characteristics

The objective of a PR&U can be viewed from different perspectives. As described in the appendix, "Reasons for a provision for risk and uncertainty", it can be seen (1) as the reward for risk bearing, measured in terms of the inherent uncertainty in the estimation of insurance premiums and reserves and in the future financial return from the policy, or (2) in a pricing or solvency context as the amount to cover adverse deviation that can be expected in normal circumstances, with capital to cover adverse deviations in more exceptional circumstances. In a market-consistent world, these alternative perspectives (regulator, policyholder, insurer, and investor/potential transferor) should result in similar measurement results.

The following are desirable characteristics of any method of PR&U incorporated in the calculation of premiums or reserves:

1. Consistent with applicable regulatory framework;
2. Consistent with sound insurance pricing practices, regulatory solvency principles, and actuarial standards;
3. Practical, understandable, and straightforward;
4. Transparent, auditable and verifiable;
5. Not over-reliant on subjective inputs;
6. Use current estimates;
7. Consistent among insurers with similar business and between insurance coverages, if practical; and

8. Consistent over the entire lifetime of the policy and between generations of products.

All else being equal, desirable movements of a PR&U include:

1. The less that is known about the risks involved, the larger the PR&U;

2. Risks with low frequency and high severity have a larger PR&U than risks with high frequency and low severity;

3. For similar risks, policies that persist over a longer timeframe will have a larger PR&U than those of shorter duration;

4. Risks with a wider probability distribution will have a larger PR&U than those risks with a narrower distribution; and

5. To the extent that changes in assumptions due to emerging experience or the effect of mitigation techniques reduces uncertainty, a PR&U will decrease, and vice versa.

These can be used to help assess various PR&U methods. A methodology for calculating the PR&U should satisfy as many of these characteristics as possible.

On first blush, the use of probability distributions in these methods seems to only reflect process risk, rather than uncertainty, which by definition is less measurable and less subject to stochastic processes. Approaches that have been used include the use of (1) probability distributions with a larger variance than would be the case if only process risk existed, (2) asymmetric probability distributions, reflecting both more extreme adverse risks and risk appetite/tolerance/preference, (3) decreased correlation, under the assumption that the source of uncertainty would be more likely to adversely affect multiple experience assumptions, (4) a higher level of required confidence, whether in terms of quantile levels, economic capital or lower discount rate, (5) increased PR&U resulting from assessment of the results of additional testing of sensitivity or stress testing under alternative scenarios, and (6) judgmental adjustments, especially in aggregate or top-down methods.

Market consistency

As this paper primarily deals with non-hedgeable risks for which an efficient market does not now exist, it is not possible to determine whether a method is market-consistent. However, the PR&U can be based on assumptions and approaches that a market participant would be expected to use, reflecting current expectations. To be market-consistent, the PR&U should be sensitive to changes in the market to the extent observable, reflecting an allowance for risk and uncertainty that is inevitably included in any transaction price.

Some observers have expressed a belief that the use of a market basis for PR&Us, in theory or in practice, is inappropriate, in that unless and until a relevant market in which transaction prices are reliable arises a PR&U would not be verifiable nor calibration possible.

In contrast, others believe that the effort to arrive at market-consistent values, at least in theory, is worthwhile. In any event, ascertaining the objective of pricing and reserve measurement is relevant in the determination of margins. As long as the measurement objective is based on market participants' views, PR&Us should reflect changes in market participants' risk preferences as reflected in prices for accepting risks. Market-consistency in practice is considered more important for general purpose financial reporting than for pricing or regulatory reporting.

Regulators and policyholders are likely most interested in an approach to PR&Us that is not necessarily based on market views (although most pricing ultimately considers competitors' premium levels), while investors and prospective purchasers are likely more interested in a market value margin approach. The perspective of the insurer may also depend on its nature. For example, a mutual insurer may give more weight to the perspective of its policyholders, while a stock insurer may focus on issues more from the perspective of the shareholders/investors.

It is arguable that for insurance policies, greater weight should be placed on the needs of policyholders, in which case a PR&U, rather than a market-consistent approach would be preferred. A pragmatic approach may be to adopt a risk criterion as a proxy for and roughly calibrated to a market basis.

Measurement methods

Several methods to measure a PR&U have been used. There is no perfect measure but instead a broad range of proxies[v]. Nonetheless, one actuarial categorization of possible methods that have been used follows:

1. Quantile

    Quantile methods are expressed in terms of a degree of confidence that the provision (in addition to the expected present value of future policy cash flows plus any existing reserve) is sufficient to provide for a designated amount of adverse experience. Each variation within this family of methods requires models to determine applicable risk distributions, so that the premium level (or amount of assets if assessing reserves) required to achieve the desired level of confidence in meeting policy obligations can be determined. The techniques within this family include:

    *   Confidence levels (Value at Risk, VaR). A given probability of sufficiency leads to a value at risk.

    *   Conditional tail expectation (CTE or Tail-Value at Risk (T-VaR or Tail-VaR)). This is equivalent to the expected present value of the cost of claims or benefits greater than a threshold value.

- Moment methods. A multiple of standard deviation, variance, semi-variance, or higher moment(s). These require the derivation of higher moments that consider the entire shape of the distribution, which requires that the shape of the entire distribution function be estimated or model-based estimators be used.

2. Explicit assumptions

Although not a totally separate approach, this variation of a quantile method is based upon a separate assessment of each major assumption separately, which includes a reflection of interactions. This approach, which may be most highly developed in Canada for financial reporting, is applied on the basis of professional actuarial standards that specify ranges within which the PR&Us must lie. Canadian actuarial standards require the actuary to add an explicit margin for each assumption.

The minimum level of the Canadian ranges provide for a minimal amount of conservatism, while the maximum is at a level that still is not so conservative as to distort income. Although not explicitly based on a quantile method, these ranges have been developed based on practice, with the expectation that actuarial judgment will be applied in the context of applicable actuarial standards about the business being valued.

One of the more challenging aspects of the use of explicit assumptions is determining the effect of the correlations among them, as they may be inter-related. For example, claim incidence rates and claim termination rates can be inversely related and active life mortality tends to be directly related to claim incidence. And they are not likely to all go sour at the same time (although some believe that this has nearly been the case for the last decade for LTCi). In contrast, aggregate methods usually reflect correlation implicitly, as they usually treat all of the individual experience assumptions on a combined or aggregated basis.

3. Cost of capital

The cost of capital approach expresses risk as a function of the passage of time and costs associated with cost assessments made on a continuous basis as evidenced by prices generated in a market. It refers to the amount of return demanded by the marketplace on an investment of capital to enable an insurer to fulfill its policy obligations after payment of income tax.

4. Discount rate

A discount rate approach focuses on the effect of risk and uncertainty as they occur over time. There is no unique accepted method for determining the discount rate adjustment for the purpose of determining a time-related PR&U. However, the following three techniques have been used in various applications:

- Risk adjusted discount rate. Usually a level, but subjectively selected margin applied to the discount rate for risk.

- Deflator adjusted cash flows. Deflators are usually applied to asset values and are constructed using market price information. As such, there are currently no practical examples in the literature on how to apply them to non-hedgeable risks in insurance obligations where there is no relevant market information available.

- Capital asset pricing model (CAPM). Although CAPM specifically was developed for the analysis of asset values, it has also been used to allocate capital that can affect certain PR&U calculations. In actuarial pricing literature it has been used as a method for determining the "cost" in a rate of return method. It appears more appropriate to apply in determining parameters for other methods, rather than as a method itself.

Examples of PR&U approaches where the effect of risk and uncertainty are applied at the assumption level can be calculated and disclosed include the following:

1. A specified mortality, morbidity or other table. For example, a current estimate of a mortality table, adjusted by x% to reflect risk (x being positive for life insurance and negative for active life LTCi policies and payout annuities).

2. A minimum loss ratio until an exposure period is sufficiently mature. This has often been applied to health insurance unearned exposures.

3. An explicit discount rate that is lower than the current risk-free or expected discount rate.

4. A fixed percentage PR&U assigned by line of business, for example, 5% of premiums for motor insurance, 10% for riskier coverages, etc.

5. A fixed cost ratio of regulatory-based capital in a cost of capital approach, which is not specific to the individual policy, for example, simply a fixed ratio of premiums or statutory reserves.

Other explicit methods include those using utility theory[vi] and hazard transforms[vii] that have certain theoretical and/or practical advantages. This paper does not explore these methods, as they have not been sufficiently investigated to determine how they could be applied in this context.

PR&Us based on conservative implicit assumptions have been a long-standing part of the regulatory approach to the evaluation of premiums and reserves of insurers. Historically in the valuation of many life and health insurance policies, these have included the use of what was believed to be conservative assumptions (an implicit method), such as a loaded mortality table and less than market discount rates. From a policyholder protection perspective, to the extent that conservative assumptions have produced larger premiums and reserves, this has sometimes been viewed favorably in this context.

It has been common for actuaries to incorporate a degree of implicit conservatism in her/his best estimates, consistent with the desire to not be proven too optimistic, in addition to being personally

risk-averse. In most insurance cases, either sufficient relevant experience information has been available or a feedback loop between experience and assumption development facilitates the development of sound estimates. In contrast, because LTCi has such a long time between initial pricing and significant benefits paid over a potentially long period, a feedback loop to assess the degree of implicit conservatism can be difficult to implement.

In any event, it is important to analyze and validate how solid the best estimate is. Incorporation of risk and uncertainty in an explicit PR&U facilitates a focus and enhances uncertainty and risk preference/tolerance/appetite, as well as providing an unbiased benchmark for performance comparisons (actual-to-expected analysis). Its use can force stakeholders to recognize and manage their existence and importance.

The use of quantile methods for regulatory purposes is of more recent origin. Australian regulators, for example, require that claim reserves for non-life insurance be set on the basis of confidence levels, subject to being at least a minimum number of standard deviations above the mean value. This was, at least in part, intended as a proxy for what market participants would consider a reasonable value.

The following are observations about these possible methods.

1. In the quantile family of methods, CTE approaches are theoretically more sound than confidence level approaches, with differences being significant for products, such as LTCi that have more skewed risk distributions.

2. A specified level for a quantile method or capital measurement in the cost of capital method can promote consistency among products and companies. Nevertheless, this consistency may not always be appropriate, as actuarial practice generally applies a higher level for products with risk distributions more highly skewed or where uncertainty is greater.

3. Explicit assumptions and discount rate approaches can be useful approximations for implementing a method such as cost of capital or quantiles.

4. Consistency between insurance products is not practical using a purely explicit assumption or discount rate approach.

5. Of the methods discussed, the cost of capital method may be the most risk sensitive and is the method most closely related to pricing risks in other industries. However, in part as a result, it is usually more challenging to fully implement than the other methods.

6. There is currently no market for insurance policies, claims, or reserves that has relevant and reliable prices that would allow any of the methods to be tested for market-consistency on an overall basis. Some approaches, like moments, reflect superior theoretical concepts more consistent with how market participants price risks (e.g., by use of utility functions) than, for example, confidence level methods that reflect a security (extreme event) perspective.

7. If equivalent assumptions are used, the application of the alternative methods has been shown to produce equivalent results.

Theoretical methods that involve probability distributions can be difficult to apply, especially when there is no quantitative basis for developing the distributions. For example, it may be easier to fit a distribution to mortality risks than to policyholder behavior (e.g., lapses), claim incidence or claim termination rates, which do not lend themselves as well to a probability distribution approach. There may also be technical challenges in combining distributions for different assumptions.

In sum, there is no single agreed-upon best method for determination of a PR&D in all cases. Historically, the approach used has depended upon the coverage involved, historical practice, and whether it is assumption-specific or an overall policy based provision. For health insurance, it has usually been expressed in terms of a percentage of premiums (loss ratio). Given the long-term nature of LTCi, loss ratios can only be interpreted over the lifetime of the product that even then requires a significant number of assumptions; therefore this measure may be less useful than in traditional health insurance coverages. It could also be additive or expressed in terms of a percentage of the present value of expected costs, which may be more appropriate for a long-term coverage such as LTCi. Alternatively, the total PR&D could be decomposed and expressed as a function of each experience assumption (note that treatment of policyholder behavior has tended to be problematic in such an approach), reflecting an applicable reduction in the PR&U due to correlation among experience assumptions.

Aggregate measures across risk type

Two general methods used for aggregate measures of risk and uncertainty both depend in some way upon an external element:

- Actuarial Appraisal Technique

  This method is described in Actuarial Standard of Practice No. 19[viii]. It often is used in pricing when blocks of business or insurers change hands between knowledgeable parties. The actuary calculates the present value of distributable earnings, the amounts that can be distributed based on regulatory requirements, while simultaneously retaining the level of capital required to support the ongoing operations of an insurance business.

- Cost of Capital Method

  In this method, the PR&U is determined by multiplying a risk measure, such as economic (risk) capital, by the insurer's cost of current and future capital applicable to the coverage provided. The method assumes that a robust risk capital formula has been used that measures all risks and uncertainties and that an appropriate benchmark cost of capital can be derived. Given a risk capital formula, the method is relatively straightforward. If this method is selected as the basis for a PR&U, then all risks covered by the risk capital would be covered by the PR&U.

In different applications, this method has been based on the risk capital of the insurer or that of a hypothetical insurer with a high rating (say A, AA, or the maximum of this measure and the actual rating). A hypothetical insurer may be desirable for use here to obtain consistent PR&Us between different insurers.

The cost of capital could be the same for all risks (at least at the same duration), since risk with greater volatility should, in theory, require greater risk capital.

The risk capital chosen for this purpose would consider:

1. The appropriate level of economic capital; plus
2. Possibly any excess of local solvency required capital over 1), as there is evidence that knowledgeable buyers take this into account; plus
3. Any additional capital required by market forces (for example, for fair value approaches) or by the insurer's capital management strategy (for entity-specific approaches).

Component 3) may be driven to some extent by 2), as rating agencies and management may set their risk capital measures based on local solvency requirements. Because solvency requirements vary from jurisdiction to jurisdiction, risk capital basis may also vary, even for fair value approaches. For example:

1. In the U.S., life insurers often target 200% of their Risk Based Capital.
2. In Australia, non-life insurers are required to hold the regulatory PR&U plus a Minimum Capital Requirement (MCR) of either the excess of a 99.5% Probability of Sufficiency (POS) margin over the regulatory PR&U, or the sum of values determined by applying a set of factors to the amounts of applicable asset and reserve classes. It is thought that many insurers aim for 150% of the MCR.
3. Canadian life insurers generally target at least 185% of Minimum Continuing Capital and Surplus Requirements (MCCSR).

In addition, rating agencies often consider their own independently current and target ratios in their analysis of an insurer, in turn influencing targets set by management.

One application of this method incorporates in risk capital the excess of the reserve over its expected value. Thus, any PR&U or market value margin included in reserves is part of risk capital.

In summary, it is best practice to consider PR&Us for all risks when quantifiable in a reliable manner and are relevant to premiums and reserves. This is particularly appropriate where there are no constraints on profit at issue. But even if such constraints exist, they would appropriately reflect expected profits after issue. In contrast with methods in which the effect of the correlation among assumptions is considered explicitly, this correlation is usually considered implicitly in an aggregate method.

Setting the level

The approach and criterion for setting a PR&U level and releasing the PR&U over time would normally be part of the pricing or product management policy of the insurer and would generally only be changed if the change results in more relevant and reliable information. In some cases, based on updated information, the apparent level of risk can change, as discussed later in this paper. The level or degree of risk and uncertainty acceptable or provided for, can also be chosen by the applicable regulator or regulatory standard that may vary by coverage or circumstance.

Despite the conceptual discussion above, currently there is no universally accepted method for determining an appropriate quantile or other PR&U level for the purpose of determining PR&Us. For example, in Australia, a 75% POS for non-life claims has led to a value at risk that will not be exceeded 75% of the time. However, that probability may not be appropriate for another jurisdiction or line of business. In the U.S. for LTCi, the principle under which the level is determined to reflect the effects of moderately adverse conditions, the quantification of which is subject to reasonable interpretation considering the risks and uncertainties that the applicable block of business or insurer is subject to.

Depending on the technique applied, it may vary by assumption(s), based on several possible factors, including, for example:

- The actuary's interpretation of moderately adverse experience;
- The actuary's degree of confidence in the underlying assumptions;
- The sensitivity of pricing results to variations in the assumptions;
- The actuary's judgment of the effect of combinations of various assumptions, their degree, and the likelihood of them being adverse;
- The insurer's tolerance of adverse financial results before considering an increase of inforce premiums; and
- Ultimately, it may be subject to approval by a regulator.

Each PR&U method requires parameters selected, possibly considering regulatory requirements, re-engineering, stress or sensitivity testing, stochastic modeling, judgment or a combination of these. The parameters needed differ for each PR&U method, including:

- Cost and capital level in the cost of capital method;

- Confidence level or other quantile level for quantile methods;

- Multiple of higher moments;

- PR&Us expressed as a percentage in the risk adjusted discount methods; and

- Margins for each or selected explicit assumption.

With respect to these parameters,

- Both disclosure of and regulatory or professional guidance regarding methods, assumptions, and the resulting PR&Us tend to produce consistency between insurers over time.

- For all approaches, the calibration to market-based values (i.e., actual transfer values) is problematic, as there are few, if any, transfers with observable prices that provide reliable calibration benchmarks. Even if such cases were to occur, such prices are not usually publicly available, involve special circumstances, or refer to such complex accumulations of transferred business that it is not practical to derive prices for specific relevant components.

- Because stochastic methods or probability distributions normally focus on process risk, a larger degree of confidence may be required to reflect the effect of parameter and model risks, although moderated somewhat due to the extent of the inter-relationships as evidenced by the correlation between the factors involved. The level of confidence used is normally at least in part set by regulators or the insurer (as designated in regulation, professional standards, or professional judgment) through use of judgment, in part because of the difficulty in validating or calibrating the probability distribution(s) used against historical experience or market prices. Validation of a particular distribution(s) is difficult, in part because of a concern that historical volatility is not necessarily relevant to the perception of risk and uncertainty related to future conditions.

- If any of the PR&U methods becomes a basis for transfers in the future, such data may make calibration more reliable over time.

Various practical methods have also been used, including:

- Factors applied to one or more assumptions. For example, a percentage factor based on a confidence interval for the claim incidence rate distribution might be applied to the expected number of new claims assumption.
- Scenario testing (viewed as being either sensitivity or stress tests), possibly using a weighted set of deterministic scenarios selected to be representative of stochastically generated scenarios. This approach is especially useful for asymmetric risks, options, guarantees, or policyholder behavior.
- Percentages, depending on the class of business and/or other variables, based on perceived riskiness applied to the expected value or loss ratio, determined by sub-models.
- The use of a wider range of confidence than if just process risk was involved, to reflect the impact of parameter and model risks.

If practical, such practical methods that involve multiplicative factors should be calibrated to one of the more theoretical methods, even if the end result may appear somewhat arbitrary or if the model used is complicated. It has to be realized that LTCi is a complicated insurance product and that as long as effective model governance processes and validation in place, being relatively complicated is not necessarily bad. However, it should be kept in mind that the application of PR&Us to assumptions can have unintended consequences if the parameters used are outside the range in which they were

calibrated. For example, reducing a 5% discount rate by a factor of 3/5ths is equivalent to a reduction by 200 basis points, but these two adjustments have a vastly different effect if the base rate is 1% or 15%. Discount rate adjustments can also have very different effects, depending on the mean estimate.

PR&Us may be required for parts of the entire insurer. This can be done in two ways: (1) by apportioning a global PR&U or (2) by allowing for diversification effects between smaller, more homogeneous portfolios.

There are several possible apportionment bases, including:

- Standard deviation or variance derived from industry or entity-specific data;
- Marginal capital;
- Myers-Read[ix] (using option pricing methods to determine how capital should be allocated across lines of business);
- Most PR&U criteria (e.g. 85% CTE); and
- Factors applied to one or more assumptions.

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

1. In explicit PR&Us as applied up to now, for example in Australia for non-life insurance regulatory reporting and less formally in other jurisdictions, the risk distributions used relate to claim/policy obligations and do not consider operational risk or ceded reinsurance credit risks. This has usually been a choice made by applicable regulators, not a necessary characteristic of a specific measurement approach. This paper assumes that the methods considered would be applied to risk distributions that reflect all of the (significant) risks associated with the applicable policies.

2. The measurement of PR&Us usually uses the current risk-free rate for discounting. If an insurer uses a higher discount rate, then the risk distributions used to calculate quantiles or capital amounts should be consistently applied.

3. Insurers often fail to hedge some or all of their hedgeable risks, in part to avoid the cost of the hedge or through lack of recognition of a particular risk. For example, this may happen when there are historically low interest rates, with the expectation (hope) that interest rates will revert to some type of historical (possibly during the last half century) average experience. The increased risk resulting from that decision should be reflected in the PR&U, and in addition in regulatory and economic capital. However, although it may be appropriate to include the cost of hedging, it may not be appropriate to reflect associated risks and uncertainties in a PR&U measurement, as this deliberate mismatch could be avoided.

4. As multiple risks are involved in insurance policies, it is necessary to consider appropriate ways to reflect the effect of a combination of risks.

In setting the parameters for the methods used as potentially applicable to LTCi, the risk tolerance of applicable stakeholders (e.g., the insurer, regulator, and investor) and other perspectives should be considered. In addition, the amount of the PR&U should reflect the expected effect of the risk mitigation approaches used (see the "Mitigation" section of this paper).

4. Mitigation

Risk mitigation is a process or actions by an insurer that can manage, control, and reduce adverse cash flows and associated risks and uncertainties. It is an integral and significant element of general corporate risk management that together constitutes a crucial function of management of all insurers. A risk mitigation technique is an action by an insurer used to manage risks associated with a block of insurance policies and a method used to enhance the expected net cash flows of the insurer or reduce the volatility associated with those cash flows. They are applied either by means of product design (for example, through product adaptability, aligning the interest of the insured and the insurer, or risk re-transfer to the policyholders) or outside the policy (for example, through pooling, diversification, offsetting, reinsurance or asset management). It is likely that, without effective use of mitigation tools, a LTCi block of business will not be successful.

Although expected cash flows are also affected by the type and expected effect of each mitigation technique, most of the discussion in this section relates to the effect of these techniques on a PR&U. In some cases, the cost of utilization of the technique is greater than the corresponding change in expected cash flows. In many cases, the effective application of risk mitigation techniques can reduce the level of uncertainty and volatility associated with the expected cash flows of insurance policies, thus reducing the aggregate cost of bearing these risks.

A general principle applicable to the analysis of the effects of these techniques is that they should be reflected in both the current estimate and PR&Us of insurance policies only to the extent that they are expected to affect the current estimates of directly related cash flows of the portfolio of insurance policies or the probability distribution of their expected outcomes, rather than the cash flows associated with the operation of the insurer. Note that in some market-consistent frameworks, if the effect of a technique is observable within the unit of measurement (the portfolio), for example through market prices, it may be appropriate for them to be reflected in premiums or reserves.

PR&Us should reflect the expected effects of risk management and mitigation features that are included within the policies or applied by an insurer to reduce the risk and uncertainty relating to the experience of the policies. Additional risk mitigation techniques include the design of policy features used to reduce the amount and volatility of cash flows and uncertainty and effective asset management strategies, such as asset / liability management techniques that reduce insurers' reported volatility, thus allowing an insurer to share with policyholders in premiums the expected beneficial effect of those practices. Feedback loops are desirable components of the process of developing and identifying mitigation approaches, measuring their effects, and consequentially revising them.

A discussion of these mitigation techniques follows.

- **Product design and alignment of insurer's and insureds' interests**

The Volatility in Long-Term Care Insurance

To better understand potential risk mitigation techniques incorporated within the LTCi product design, it is useful to understand the history of these products and some of the early misalignment of interests of insureds and their insurer. When initially offered, LTCi policies only offered nursing home benefits—although no one wants to go to a nursing home, purchasers of these policies recognized the need to insure themselves against the adverse financial effect of moving to a nursing home if absolutely needed. This represented a very close alignment in interests, in that neither the insured nor the insured wanted to have nursing home services utilized.

In an attempt to expand the market for insurance providing coverage for LTC, the next generation of LTCi policies began to offer far richer benefits, including lifetime benefit periods, benefits for home health care services and ALFs, short or no elimination periods, generous benefit increase options and medical necessity benefit triggers. The relative richness of the benefits provided, along with liberal benefit triggers, have facilitated and in fact introduced incentives for policyholders to use certain services earlier and longer than many insurers had anticipated, resulting in a potential conflict between the interests of the insurer and its policyholders, as more insureds desire to make use of more such services.

In the late 1990s and early 2000s, tax qualification for LTCi premiums required more stringent benefit qualification triggers for LTCi premiums. This led to a move toward ADL claim triggers rather than medical necessity triggers. These more stringent benefit requirements removed some of the ability of insureds to claim benefits before a significant need for LTC services that LTCi was intended to cover.

There are several LTCi product features that can reduce the volatility of experience of those policies, with some that can also result in reduced cost. They can reduce or delay claim incidence or decrease the severity of a claim once it occurs. In general, the less rich (less liberal) the benefits in a policy, the more likely lower volatility will occur due to lower frequency and severity of claims. This reduction is due in part to the effect of anti-selection and moral hazard—avoiding or reducing the effect of features that can create a difference in interests may reduce volatility in experience, as well as reducing insurer costs. For example, inclusion of home health care and ALF benefits, although viewed by many consumers as being desirable and making LTCi policies more marketable, introduced significant policyholder options that might result in experience that differs from earlier insurer expectations.

The economic nature, effects on behavior and attitudes, and consequential risk mitigating effects have to be evaluated on an individual and combined basis to determine their proper treatment and estimate their effects.

Additional policy mechanisms, including longer elimination periods and benefit limits (daily/weekly/monthly maximum benefit options, length of period of maximum amount of benefits), have been used to transfer risk back to insureds, thus tending to reduce risk and uncertainty. Benefit limits serve as a mitigation approach, which can also influence behavior (that is, provide an incentive

to an insured to preserve available aggregate limits or even possibly to seek or negotiate lower fees for services to avoid going over benefit limits). A policyholder is more likely to use services if they are, or are perceived to be, free or provided by insurance. Elimination periods, co-payments (coinsurance), and usual and reasonable charge limits also transfer some of the LTCi risk to the policyholder, in some cases changing policyholder behavior by reducing unneeded (or unnecessary) services.

Other approaches that might be taken to align interests include:

- Development of preferred provider networks, in which insurers would receive reductions in charges, while at the same time provide incentives to enhance quality of care, could better align the interests of those who utilize those services.
- Wellness discounts that provide reduced premiums as long as maintenance of good health is demonstrated on a regular basis, which can provide an incentive to maintain a healthy lifestyle and in turn reduce claim incidence.
- Inflation benefits for as long as the insured remains claim-free for a specified number of years, say three, or are not currently on claim. This variation in benefit increases might be accompanied by an increase in maximum benefit limits.

In addition to the misalignment of interests between the insured and insurers, monoline LTCi policy design encouraged a "use it or lose it" attitude toward the coverage, given its lack of cash values and limited death benefits for policyholders that do not expect to use their LTC benefits. This in turn led to the development of another type of risk mitigation through product design by means of a policy that combines benefits for LTC services with either an annuity or life insurance coverage. These policies typically require policyholders to reduce their future life insurance benefits to fund LTC services prior to the insurer covering additional LTC benefits. This also tends to reduce some of the adverse selection of policyholders who fear the loss of the value of their life and annuity benefits and encourages them to conserve their total benefits, thus aligning their incentives with those of the insurer. This bundling of different insurance coverages tends to produce less cash flow volatility, since benefits are paid out whether or not LTC services are needed (although unrelated sources of variability may arise, such as death or surrender benefits).

9. Combination of risks

Three of the basic approaches to the combinations of risks that enable insurance to offer coverage for contingencies that an insured would be unable to successfully bear by her/himself are pooling, diversification and offsetting. These are discussed in the following.

Pooling of similar risks

Pooling is the application of the law of large numbers to coverage of contingent events, to the extent that the risks involved are homogeneous and independent (sometimes referred to as *unconnected*) risks. Pooling, the essence of insurance, is a fundamental insurance risk mitigation technique that reduces volatility, that is, random fluctuations around the expected (mean) value of a portfolio of similar policies. Although pooling does not by itself reduce the uncertainty (parameter and model risks) about what the mean value is[x], it does reduce the expected deviation around the mean (process risk, also referred to as random deviation risk) expressed as a percentage of that mean. Adding similar policies to the insurance pool reduces the process risk of LTCi-related outcomes such as claim incidence and mortality to take advantage of the law of large numbers. Thus, a small insurer or a business unit within a large insurer can lower its risk from statistical fluctuation on its premiums or reserves by writing additional similar policies.

Pooling enables experience analysis results to form the basis of the parameters and risk distributions used in pricing models. For example, claim frequency is often modelled using a Poisson distribution, in which the standard deviation of the rate of new claims is the square root of the expected rate of new claims, and the coefficient of variation (standard deviation divided by mean) will decrease in inverse proportion to the square root. Thus, while the expected value of, say, claim incidence, per non-disabled policy for a small group of policies is the same as the expected value per policy for an otherwise similar but larger group of policies, the risk distribution for the smaller group is wider (i.e., has a larger coefficient of variation), with possibly more skewness. Thus, pooling similar risks results in a reduction in the process risk per policy and the indicated PR&U can be reduced.

Diversification

Diversification aggregates risks that are less than 100% interdependent. Diversification is a critical risk mitigation feature in the insurance business which underlies many important risk management processes. The combination of risks that are not totally independent of each other results in a diversification effect: the total risk measure (e.g., VaR, TVaR and standard deviation) for the combination of sub-risks is equal to or less than the sum of the risk measure for each sub-risk.

The diversification effect can be calculated at several levels, between:

1. sub-risks within a risk type;
2. risk-types within a modelled block of business, for example, a single line of business or business unit;
3. inforce and newly written business, the premiums for the latter being at a more adequate level and underwritten in a more restrictive manner; or
4. policies or types of coverage of different lines of business and/or business units.

A risk or portfolio of risks is diversifiable if a sufficiently large number of dissimilar risks is available to spread the fluctuations caused by the risks so that the variability of the total portfolio is less than the sum of the variability of each component considered in isolation. The distinction between

diversification and pooling is based on the degree of similarity or dissimilarity of the risks involved. This similarity can be assessed based on one or more characteristics of the risks, for example, class of business, location of risk, marketing channel, and type of insured.

An insurer that writes only one line of insurance is called a mono-line insurer. Advantages of this type of insurer can include the perception of being a specialist or expert in the market, having the expertise to treat its policyholders fairly and achieving lower operating costs. Conversely, a mono-line insurer does not have the advantage of being able to spread risk among heterogeneous product lines. By writing different types of risks or coverages, an insurer can diversify and therefore can reduce the volatility of its aggregate losses, as well as lower its PR&U and in turn premium rates.

In assessing the effect of combining different lines of business or coverages (e.g., LTC and life insurance), the risk and uncertainty remaining after consideration of pooling within each line might be diversified to some extent by their combination. The resulting risk distribution for all policies combined would have a lower skewness and coefficient of variation than the average values for each line considered independently. Similarly, the confidence level selected for a quantile method and the required capital for the cost of capital method would be less than the sum of the separately assessed PR&U or capital amounts if inter-line or inter-portfolio diversification effects are permitted to be considered.

The reflection of the effect of at least some diversification is unavoidable, even within a portfolio of policies, as no two insurance exposures are exactly identical. A portfolio of LTCi policies, for example, will by necessity include a demographic mix of insureds and a variety of product features. Completely ignoring the effect of diversification would be inconsistent with the underlying economics involved. As a result, since diversification is involved in any event, when considering the effect of diversification the appropriate decision is the extent to which diversification is reflected and not whether it should be recognized.

Offsetting risks

Offsetting combines risks with a very high negative correlation, if not negative one (sometimes referred to as *opposite risks*). Offsetting risks is a risk mitigation technique that takes advantage of the large negative correlation between two sets of obligations or rights (items) that can reduce the risk associated with the first set of items.

A special case of offsetting risks is matching or hedging. Hedging achieves its risk mitigating effect by combining strongly negatively-correlated items that are otherwise independent from the items offset. An example is a derivative designed to completely offset a certain risk; however, if such an offsetting item does not refer explicitly to the effect of the item involved, but rather to something external to it, such as an index, the offset might not be effective in all circumstances.

Transferring the risk through offsetting can be made through (1) policy reference to the item born by the insurer, thereby offsetting the risk by transferring the specific risk of the insurer directly to a counter-party, through risk-retransfer to policyholders (e.g., through a participation feature) or (2) by other means, such as through reinsurance. Such techniques are usually directly linked to the effect of the risk offset, thus effectively reducing or eliminating a part of the risk otherwise born by the reporting insurer, except for the default risk associated with the counter-party.

An example of offsetting with respect to LTCi is active life mortality and the mortality risk of whole life insurance policies written by the same insurer to the same market. This offset is not usually recognized, however, because the results from these two coverages are not normally looked at on an aggregate basis. Another form of internal offset is LTCi active life mortality and disabled life mortality in the aggregate; although the mortality from these two groups is usually quite different, they tend to move somewhat in the same direction, in which case their financial effects can offset each other.

- **Higher premiums**

  Although larger premiums for the same benefits and policy features do not reduce the absolute amount of volatility of expected costs, they do reduce the probability of a loss, as well as reduce the amount of volatility expressed as a percentage of premiums. Another way of expressing this – the more conservatively the assumptions are set, the larger the premiums and in turn profits (or reduction in losses) will be.

- **Rate increases**

  LTCi policies, written on a guaranteed renewable basis, are guaranteed to remain inforce as long as the premiums for the policies continue to be paid (unless waived through a waiver of premium feature). At the same time, this policy feature enables, if based upon adverse experience sufficient to justify an increase and agreed upon by the applicable regulator, these premiums to be increased to offset experience significantly worse than initially expected.

  Because of the extent of uncertainties involved in providing LTCi coverage, guaranteed renewability has been a crucial factor in enabling insurers to offer LTCi. Nevertheless, in part because of the effect of rate increases on the continued affordability of LTCi coverage and expectations of the often elderly policyholders, it is often considered a safety valve to be used only if other sources of net costs are not able to be controlled.

  Such potential premium adjustments can reduce the effect of significant adverse experience expected to continue. However, its effectiveness is limited by at least three factors:

1. The lag between recognition that the adverse experience to the insurer is as a result of parameter or model risk rather than process risk and when corresponding rate increases are implemented, in part as a result of the insurer's risk tolerance;
2. The insurer may not request the full amount of the effect of adverse experience; and
3. A certain percentage of rate increase requests may not be approved (referred to as "regulatory risk").

As a result, the effect of this mitigation technique does not cover the total amount of adverse experience or expectations. These three factors are inter-related, as the long lag period it takes to observe statistically credible experience of mature blocks of LTCi business impedes the ability to sufficiently demonstrate adverse experience compared with earlier assumptions limits the willingness of regulators to approve rate increases needed by insurers to maintain a reasonable level of profitability.

- **Dividends and other discretionary benefits**

Some insurance policies provide benefits that are not specified (either as to amount or the method to be used to determine the amount) in the policy. These non-guaranteed features can take the form of (1) a share of the surplus generated by a pool of policies determined by the insurer's Board in excess of the amount determined in the policies or through law or regulation or (2) benefits that either exceed the amounts guaranteed or in charges/premiums that are less than those guaranteed. They can be provided as a result of competitive forces (at the time of sale or to maintain the policy inforce or in a premium-paying status) or determined on the basis of an equitable allocation of generated funds. Such discretionary elements can help mitigate the effect of adverse conditions and enhance the manner by which an insurer manages its policies' risks.

Although insurers usually have the ability to pay more than actually required by the policy, some mutual insurers have made use of that ability through the payment of participation features (policyholder dividends), in some cases paying policyholder dividends, or through other non-guaranteed elements, such as in claims settlement or by paying benefits in excess of that required by its policies, although for LTCi such additional benefits have been relatively rare.

In contrast to amounts directly determined from the rights and obligations under insurance policies, these benefits may be treated differently, depending on their characteristics. In a current estimate, the expected cash flows of these non-guaranteed benefits would be included in a manner consistent with the derivation of the guaranteed benefits. In modeling risk and uncertainty, reductions in a dividend scale if the actuary is convinced that such a reduction, if applicable, would be implemented in a given set of circumstances, can temper or reduce the severity of an experience tail.

- **Investment oriented mitigation strategies**

Although risk mitigation approaches that involve the management of assets are not unique to LTCi policies, they can be important nonetheless. Because of the ultra-long duration of some of the cash flows associated with LTCi, some asset-based mitigation strategies to enhance the stability and reduce overall income volatility can usually only be applied for early policy durations.

Other investment risk mitigation strategies, such as the use of financial options or futures, are sometimes applied. These are referred to as asset/liability management (ALM) strategies and techniques. The objective of these approaches is to reduce mismatches and volatility effects between the cash flows associated with an insurer's assets and insurance obligations and to ensure they are managed in a consistent manner to reduce expected and reported investment losses, reporting variability, and liquidity risks. To the extent they are applied successfully, an insurer's reported losses and volatility will be mitigated.

A less specific approach is to use a replicating (minimum risk) or matched portfolio as a benchmark against which actual investment strategies are compared. Under this approach, financial performance is seen as comprised of two parts: (1) the insurance result, measured on the basis of the benchmark investment strategy and used for purpose of assessment of LTC operating management and for rate increase purposes, and (2) the value added by investment management, based on a difference between the actual and benchmark portfolios. Such a division is consistent with the idea that future rate action and the value of reserves should be solely or primarily a function of the insurance obligations alone.

- **Avoidance**

Of course, the easiest approach to risk management is simply not to write the coverage or enter the market in the first place. This approach has been used by several insurers that have exited the LTCi business to avoid new exposures, either through a sale, whose LTCi business previously written is placed in run-off mode, or whose product offerings have been significantly reduced. There are a variety of reasons for these actions, including concerns regarding the recent low interest environment, regulatory capital needed for LTCi exposures, past losses, deciding that this coverage no longer fits well within their current business model, and the risks and uncertainties involved.

Underwriting, or selection of risks, is an important insurance tool used to avoid risks that do not appear to the insurer to represent an acceptable insurance risk. It can also be used to categorize potential insureds by risk classification to provide insurance at a premium level based on their expected cost, to reduce the effect of anti-selection and moral hazard.

- **Ceded reinsurance**

From the perspective of the insurer, ceding part of the risk through reinsurance will reduce a portion of the insurer's LTCi risks and uncertainties. Reinsurance enables an insurer to extend its pooling and

diversification outside itself. Expected volatility to the direct insurer is less than it would be in the absence of reinsurance. Reinsurance can be distinguished from hedging with derivatives since it is itself an insurance policy and the policy refers explicitly to the risk born by the insurer and not to an external index. It is effectively a transfer of a risk born by the insurer to another insurer[xi], that is, a cession through a reinsurance treaty. Depending on the form and provisions, ceded reinsurance can reduce insurance tail risk.

It can take the form of proportional reinsurance (where the reinsurance takes on a proportional share of the total risk of a portfolio) or of non-proportional reinsurance (where the reinsurer's share takes a different form, possibly an amount in excess of a specific retention limit or an amount in excess of a specific stop-loss limit). In either form, the primary objective is to reduce the volatility of risk or increase capacity within the direct writer. The effect of non-proportional reinsurance on expected cost is usually proportionately less, often much less, than its effect on the coefficient of variation of the risks. The impact on skewness and higher moments, and thus on volatility, is greater.

Although the general principle that, before allowance for reinsurer default, the PR&U for the ceded part of the insurance risk should be consistent with the PR&U for the ceded premiums or reserves still held, the effect is not necessarily proportional to the PR&U applicable to the retained obligations. For non-proportional forms of reinsurance, the ceded portion of the coverage is usually more uncertain than the total risk written. This can be achieved by estimating the net PR&U directly on a net of ceded reinsurance basis, so that the ceded PR&U is the difference between the direct and net PR&U, rather than calculating the net PR&U as the difference between the PR&Us for the direct and ceded portions. This approach uses the greater stability of the net result to determine a much more reliable estimate than is possible using the more volatile gross and ceded probability distributions.

It should be noted, however, that the net expected cost and PR&U must both include due allowance for the risk of reinsurer default, as counter-party risk should be considered in the measurement of the effect of ceded reinsurance in pricing or in a reinsurance asset.

- **Monitoring experience, accurate data, and more refined models**

The more relevant and reliable information and experience with respect to that information and how it relates to the items being priced, the smaller the risk and uncertainty associated with that estimation will be.

The higher quality the performance-related information, the more refined the benchmarks and more effective the analysis, the sooner the insurer can identify performance issues that need to be addressed. If adverse experience (compared with expectations) emerges, earlier rate actions will be facilitated and enhanced information supporting a rate increase filing be will more efficiently available. It can also enhance the ability to manage the operation more effectively (e.g., controlling operating expenses, appropriately managing the claims function and communicating with different

areas of the company). The approach taken to address any problem that emerges will depend upon the reason for the adverse experience, and might better be able to distinguish between simple statistical fluctuations and changes in underlying conditions and experience. Regular monitoring and investigation of experience is needed whenever significant deviations are observed.

Early warning metrics are useful in investigating whether apparent trends are real or just a result of process risk. Analysis of actual volatility, that is, changes from prior expectations, is quite important in LTCi, although as discussed earlier it can be challenging to discern temporary statistical fluctuation (process risk) from permanent underlying changes in or unanticipated trends in experience (parameter or model risk).

It is most important to maintain a regular experience monitoring system of the primary sources of uncertainty, that is, true deviations from expectations. Accurate data that has a consistent interpretation in recording and analysis is important to reduce information risk. For example, a sudden shift in reported claim experience might be due to changes in coding (e.g., intentional or as a result of improper training of staff) rather than a change in experience itself. A lack of understanding of changes in data or processing, or conditions such as a change in claim backlogs, may introduce volatility in reported results that is not real. Effective and regular communication between the actuarial and financial areas of the insurer and claims (operations) can mitigate information misinterpretation.

The effects of the law of large numbers and the effective use of information obtained from the experience from a pool of similar policies can also reduce the uncertainty associated with an estimate of the mean directly derived from the historical experience of the pool (sampling risk). For example, experience from a large number of similarly underwritten insureds covered by the same policy features in the same market can provide relevant experience, while experience from (1) a handful of insureds, (2) underwritten by very different rules thirty years ago, (3) based on morbidity or mortality experience thirty years old or from life insurance, (4) based on non-insured data, or (5) of only from the first few policy years, may provide an unreliable experience base from which to project future experience.

Relevance of the experience is affected by the time between experience gathered and the period to which a projection is made because both (1) differences in the mix of exposures in the historical pool and those in the expected pool and (2) changes in conditions between the observation and expected future period as they affect the risks involved. The estimate of a mean might, for instance, be based on experience of a much larger population of risks or a true mean could, in cases such as many fair gambling games, be known exactly, both of which reduces the expected deviation around the mean expressed as a percentage of that mean. Thus, a small insurer or a business unit within a large insurer can reduce its risk from statistical fluctuation of its results on its insurance premiums or reserves by writing or by other means obtaining additional similar policies. The effect of the law of large numbers can therefore facilitate a greater confidence that the results from the pool from a more reliable base from which to derive an estimate of future experience from the pool.

Nevertheless, it has to be remembered that, to the extent the experience is not relevant to the policies whose experience is being analyzed, such additional information may not be useful.

Better data, modeling, and experience-related governance can reduce the size of the PR&U. In turn, a smaller PR&U allows for more competitive rates. This emphasizes the need for regular and effective experience monitoring and management.

A more refined model or rating relativities that more accurately reflects expected cost can be more responsive to changes in the mix of inforce business or claims. Looked at another way, aggregations (larger groupings) of policies or claims in risk classification can contribute to uncertainty if changes or deviations from expected in insured mix and adverse selection occur. For example, unisex rating can result in a larger risk classification mix risk, subjecting the insurer to uncertainties associated with the percent mix of genders, both at issue and subsequent if a different rate of policy terminations risks by gender occurs. Similarly, this risk can arise if the percent of any sub-group, such as marital status, with a different expected costs, is different than the expected mix from which pricing was based (although given a certain targeted market segment, changes in gender or marital status mix usually tend to change slowly over time). In addition, although it may be somewhat easier to study experience one (risk classification) variable at a time, rather than through multivariate analysis, analysis one variable at a time inevitably results in a less accurate model and may lead to cross-subsidies.

More refined rating facilitates a greater degree of pooling, while reflecting expected cost relativities. For example, the use of gender-specific rates (rather than unisex) is more responsive to changes in gender mix over time in terms of expected costs and homogeneity of risks. This reduces change of mix risk.

In summary, mitigation efforts by LTCi insurers have included the following approaches:

- Continued efforts to better align policyholder incentives with insurer incentives, including reduction in richness of certain offered benefit features;
- Product-specific considerations, such as product design;
- Increased use of non-guaranteed elements, such as dividends associated with higher initial premiums;
- Increased use of hedging, especially of long-term investment risks or development of new financial instruments whose return is a function of LTCi industry trends;
- Obtaining relevant and refined experience and other information from both internal and external sources to confirm the reasonableness of current assumptions, especially if they are proven leading or early indicators of future performance;
- Diversification of risk, including use of combo products;
- Enhanced underwriting, focused more on LTC risks;
- Enhanced and more credible volume of relevant policy and claim experience than is publically available;

- Enhanced management information and experience data quality, to enable earlier corrective actions; and
- Enhanced modeling and assumption governance.

There is usually a cost associated with the application of risk mitigation techniques, either in terms of expense and resource usage, competitiveness/volume of business, or internal resources. Nevertheless, the cost associated with the implementation of mitigation is integral to the effect of the mitigation in terms of reduction in both expected cost and risk and uncertainty. In some cases, however, the effectiveness of a technique will also be uncertain and may continue for a long period. To the extent that there is uncertainty associated with the cost of mitigation, the premium or cost associated with this uncertainty would be reflected in the PR&U.

Nevertheless, these techniques can be used to mitigate the effect of potentially adverse experience relative to expectations, at the same time reducing the need for as great a PR&U in LTCi premiums (and reserves). In contrast, any richer (more liberal) benefits may provide unintended incentives to utilize (and for relatively long periods) long-term care services or to continue policies inforce to the time when such services will be needed. This may lead to an insufficient PR&U to cover the financial effects of adverse experience compared with that expected.

5. LTCi and volatility

The objectives of this paper include the identification of the drivers of the risks and volatility of a typical LTCi block of business and a description of approaches to measure and mitigate the risks involved. This section focuses on the key areas of assumptions and product features present within LTCi that currently drive these risks, as well as an assessment of future risks associated with LTCi.

As discussed in the "Methods of quantification of risk and uncertainty" section of this paper, explicit approaches to measure the PR&U include those on an assumption-by-assumption basis and those developed on an aggregate policy or portfolio basis (the latter includes cost of capital, market-consistent, and discount rate methods). The "Mitigation" section of this paper points out that mitigation techniques are important factors in managing LTCi and should be reflected in both the expected cost of LTCi policies and in assessing risk and uncertainty. The concepts discussed in this section, although primarily focused on an assumption-by-assumption approach, also can be used as a guide to development of an aggregate approach. It also discusses the assessment of volatility and implications to the development and assessment of a PR&U in LTCi.

LTCi coverage is often viewed in two phases. The first includes the period prior to the need for coverage, often determined on the basis of a lack of a certain number of ADLs needed for benefit payment. The second is the period subsequent to the initial claim incurral. Given the number of assumptions and the wide range of possible future outcomes, the potential for volatility in the projection of these assumptions is significant.

A discussion of crucial assumptions that underlie both of these phases follows, together with implications for volatility. The first set discusses LTCi-specific experience assumptions, followed by business related risks common to both LTCi and other insurance coverages.

- **LTCi risks**

    An explicit PR&U reflects the pooling of insurance risks, including claim incidence, the cost of providers relative to the maximum payment for a given time period of those providers' services, and the death or recovery of those who receive services. The following indicates the key factors involved in these areas of experience.

    − **Claim incidence**

        Expectations of an LTCi policyholder presenting a claim are typically considered a function of the risk characteristics of the policyholder, coverage features including the effect of elimination period and benefit limitations, and geography. Unlike, say, life insurance, the use of services for which LTCi will compensate is in part discretionary and subject to the insured and family attitudes/behaviors; claims can occur as a result of the physical and

mental condition of the insured, changes in living or financial conditions, availability of informal care, and attitudes toward the range of possible LTC services. For LTCi, key contributing factors include:

- **Benefit triggers**

  Policy features include a description of conditions under which LTC benefits can be received (benefit triggers). Instead of a requirement to be unable to perform a certain number of ADLs, it may alternatively consist of medical necessity (MN) that requires a doctor to document the need for services or being unable to perform instrumental activities of daily living (IADLs). As expected, the more stringent requirements that have developed over time have led to a lower frequency of claims qualifying for payment.

- **Family circumstances**

  The ability and willingness of family members to provide care to the insured can influence the incidence and use of LTC services.

- **Types and levels of care service available**

  Over the past two decades, significant changes have been made to the types and levels of care service available, especially with respect to a significant growth in the usage of assisted living facilities (ALFs) by LTCi policyholders. The effect of assisted living facilities has not simply been an increase in supply of services available, but they also can provide more desirable living facilities in which claimants would be expected to have a longer life expectancy while on claim than someone admitted to a nursing home, with longer durations of care as well (compared with those expected prior to the availability of ALFs).

  Similarly, it has been observed that during times of economic crisis, such as 2007 through 2009, there has been a significant increase in available trained home health care aides, due to fewer job opportunities in the rest of society. This in turn has affected trends in usage of home health care services. Although there has been a recent trend in preference toward community and home care rather than institutional care that will continue at least over the short- and intermediate-term, the long-term demographic shifts toward smaller family size and movement of retirees to warmer climates may indicate that in the longer-term, this shift might reverse itself.

- **Policyholder options**

  Significant observed deviations can arise when a policyholder has an incentive to conserve benefits. For example, policyholders with a shorter elimination period are

more likely to go on claim, especially as it relates to home health care or ALF benefits, since there are limited upfront costs for going on claim. Similarly, policyholders with unlimited benefits have a tendency to go on claim earlier, given that they have no need to conserve benefits, compared to a policyholder with limited coverage.

Volatility can also arise from changes in transitions between care situses, especially from home health care service to residence in ALFs or nursing home. As ALFs have come to be perceived as residential options, increasing use of them has occurred. With continuing aging among policyholders, the rate of this change could accelerate or decelerate. New claim incidence, recovery, and continuance probabilities will change, as a result of deviations from expected and possibly increased cost.

- **Deaths**

Because most LTCi policies contain a relatively small death benefit (in some cases a return of premiums paid-to-date, while in others there are no death benefits at all), the direct death benefit risk is normally quite small. In combination products, this is not the case, as life insurance benefits may be quite substantial.

In any case, there remains a significant risk associated with misspecification of deaths as to whether they are due to whether or when the insured's LTC benefits will be payable. The advanced ages at which most LTCi is issued and expected to be eligible for a claim, as well as the long time period between the purchase of LTCi coverage and the usage of LTC benefits (often measured in terms of decades), means that mortality levels and their trends can have a significant effect on the amount of LTC benefits ultimately payable for a block of LTCi policies.

In addition, differences in mortality rates between policyholders who are not on claim and corresponding mortality rates of policyholders on claim can significantly affect the projection of experience and the number of policyholders eventually presenting a claim. Some insurers have overestimated active life mortality experience. This results in a projection of a smaller amount of future benefits, given that fewer policyholders are assumed to live long enough to present a claim, an effect similar to greater-than-expected voluntary lapse rates (see "voluntary terminations" below), which results in a greater number of claims. On-claim mortality experience has in some cases been correspondingly underestimated, which can lengthen the average period during which benefits are payable. This underestimation has been due in part to lack of credible entity-specific LTCi mortality experience, especially at longer policy durations and older ages, and a different mix of conditions than expected. Both of these deviations compared to that expected result in worse insurer profitability than expected.

Active life deaths while inforce have tended to be under-reported in LTCi (because unless there is an explicit death benefit, there is little incentive to report a death as a cause of lapsation). As a result, insurers have determined by several means, including identifying deaths by use of a "Social Security sweep" or equivalent, in which lapses are checked against publicly reported death records (yet even the use of such methods may not capture all deaths). A misallocation of termination cause might provide a bias in future projections, especially if a trend factor is applied to mortality.

If a claim cost pricing or reserving model is used (with rates of mortality, lapse and claim incidence based on both active and lives on-claim, rather than just active lives), a miss-estimation of the ratio of active to total lives may be especially significant due to the large differentials in mortality rates between these sub-populations. If a first principles model is used (with rates of mortality, lapse and claim incidence, based only on active lives not on claim), rates for this population at older ages may be difficult to estimate because limited experience may be available at those ages.

$-$ **Benefit utilization**

Benefit utilization, the amount of the stated policy benefit that is payable by the insurer (referred to by some as "salvage"), is a key assumption for LTCi coverage. One source of difference in experience compared with that expected has arisen as a result of the relative growth in LTCi costs (payable to a benefit provider) in comparison to the annual growth in the amount of coverage that a policyholder has bought (either through automatic benefit increases or guaranteed purchase options), if any. A projected shortage of home care aides and gerontological nurses has in some cases led to higher claim utilization—this may also result in an increase in usage of community care compared with facility care.

Benefit utilization can also differ by whether benefits are payable on an indemnity or reimbursement approach. If indemnity based, that is, with a fixed amount per unit of service (e.g., daily), it has less volatility than if the benefit provided is subject to the actual amount charged by the provider. In both cases the frequency in the number of home health visits (e.g., visits per week) can differ by policyholder.

$-$ **Benefit recoveries**

The number of recoveries observed can be highly dependent on the following variables:

▪ **Claims Review**

An insurer that regularly reviews claims and policyholder eligibility tends to have a greater amount of recoveries from those on claim if it is demonstrated that a policyholder no longer qualifies for benefits. Once an insured is admitted to a facility,

such as a nursing home, or has been demonstrated to suffer from dementia needing care, there is limited likelihood of a recovery.

▪ **Diagnosis**

Policies that provide coverage for relatively short-term conditions, such as services related to recovery from knee surgery or hip replacement, lend themselves to greater rates of recovery. Alternatively, policyholders who have a cognitive condition such as Alzheimer's disease, from which recoveries are not expected, will have much lower rates of recovery and longer periods of claims. The percentage of those suffering from dementia has been greater than some earlier expectations (experience usually ranging from thirty to forty percent of inforce claims) in spite of recent decreases in rates of cognitive illness in the general population. This has resulted in claim continuance experience correspondingly longer than expectations. If this trend changes, the uncertainty associated with current expectations will change as well.

– **Voluntary terminations (lapses)**

An active LTCi policyholder has the option to discontinue payment of premiums and consequently to forego the potential for future policy benefits. When policyholders lapse their LTCi coverage, they leave equity with the insurer, making LTCi a "lapse-supported" product. Lapse risk is the risk that the policyholder may anti-select against the insurer, that is, the worst LTCi risks lapsing, by exhibiting different policy persistency than assumed in pricing the policy.

In the early years of LTCi pricing, the assumption for lapse rates (often consistent with those for life or other health insurance policies) was much larger than what was subsequently observed. The lower actual lapse rates (for some insurers running at a 0.5% annual rate for later policy years) are due in large part to the realization that it is likely that LTC services will be needed at very old ages, that is, these policies satisfy a substantive need that policyholders are willing to pay relatively high premiums for a long period of time. While insureds with a relatively low level of risk might purchase less expensive insurance policies from another carrier, that is not the case in LTCi, as premiums increase substantively with age and it is unlikely a policyholder would be able to find a less expensive policy.

While historically ultimate lapse rates have been ultra-low, there have also been spikes in lapses due to non-traditional reasons. These reasons have included:

- Policyholder reaction to significant rate increases that have occurred, which include partial lapses (in the form of benefit reductions) that are taken in lieu of rate increases;

- Lapses at older ages due to policyholder expectation of death or changes in personal circumstances prior to the need for policy benefits; and
- Lapses that occur after benefits have commenced due to exhaustion of the majority or all of the maximum amount of benefits payable.

It is important to obtain information regarding experience and to reduce the uncertainty associated with the lapse rate assumption. Other assumptions can also be affected by these occurrences, including possible claim incidence anti-selection.

In addition, the ultra-low lapse rate (that is, lower than earlier expected and the lowest of any insurance product) might be a signal that insureds greatly value the coverage protection and thus might prove to represent a higher risk of claim incidence and continuance than initially expected or those not covered by these policies.

- **Asset related risks**

Since a LTCi policy involves pre-funding (that is, on average, premiums for a portfolio of LTCi policies are received well in advance of the need for providing benefits), asset investment risks and uncertainties will be encountered by an insurer. These risks typically take the form of market risk, interest rate risk, reinvestment risk, credit risk, and illiquidity risk (the latter includes asset/liability mismatch risk). Due to the very long-term nature of a LTCi policy, these risks can be significant. In a projection of expected cash flows and expected effects of the asset-related risks, often stress or sensitivity tests are often performed, e.g., the so-called "New York 7" or stochastically developed interest rate scenarios.

However, to determine premiums (or reserves), a discount rate is needed—typically the choice is between an expected asset portfolio rate and the current yield curve rate. In any event, expected credit defaults and a market risk premium would be reflected (often a market-consistent risk premium associated with the credit rating of the invested asset portfolio). If cash flows are discounted at rates implied by a duration-replicating portfolio of risk-free assets, it would be appropriate to reflect credit or market risk in the discount rate inherent in the calculation of the PR&U. Some believe that asset/liability (or C-3 as referred to in the North American classification of life/health insurer risks) mismatch risk may be appropriate to reflect the extent that there are some durations without matching assets, while others view the non-hedgeable C-3 mismatch risk as part of business risk, which would be more appropriate to reflect in risk capital than in premiums or reserves. However categorized, an explicit charge for non-hedgeable mismatch risk is usually included in the pricing of insurance policies but could be reflected in required risk capital instead. Given the long duration of LTCi, the challenge of hedging and reinvestment risks pose a significant challenge to LTC insurers because financial instruments with a duration long enough to match all LTC benefits may not be available.

Although conceptually there is no difference between asset investment return related risks and other LTCi policy-related risks, post-rate stability approaches to this risk is treated differently, as it is assumed that changes in investment-related risks are not reflected in PR&U after post stability regulations went into effect.

- **Regulatory (rate increase) risk**

Certain State Insurance Departments have been reluctant to grant rate increases or at least the entire amount of the rate increase requested for LTCi. This has been due to a variety of reasons, including incomplete rate increase filings, inadequate rate increase justifications, and concerns about the ability of policyholders to afford the relatively large premium increases filed for. This regulatory risk has delayed, reduced, or permanently eliminated some filed rate increases. Given that rate increases are approved on a state-by-state basis, the effect has differed by State, insurer and filing. To the extent that the filed rate increases (or their corresponding benefit reductions) have not been fully approved, the insurer's future profitability from the LTCi line of business will suffer.

There is inevitably a time lag between the emergence of adverse experience and the application of a rate increase or equivalent benefit reduction, which involves the following steps, each of which is subject to uncertainty and possible delays:

- time it takes to recognize the source(s) of adverse experience;
- time from adverse experience being recognized as being permanent and the determination that this deviation from expectations warrants a filing for a rate increase;
- time it takes to receive approval from the regulator; and
- time it takes to implement the approved rate action.

The following are reasons why an indicated rate increase need may not be totally implemented:

- the insurer may decide not to request the full indicated amount;
- the regulator may decide not to approve the full amount filed for; and
- some of the policyholders may take adverse selection action, e.g., those who are less likely to make use of the policy benefits may voluntary lapse their policies or take more advantageous available options.

- **Expense risk**

Expense risk is the risk of unexpected changes in operating or maintenance expenses for inforce business, or in the run-off of the business. Some view this as part of business risk that should be borne as a period cost by the insurer. Nevertheless, expected expenses must be included in pricing and under most valuation measurement systems. Sources of risk and uncertainty include

increases in excess of that anticipated in fees charged by a third party administrator (TPA), IT expenses and general inflation. The risk and uncertainty associated with expenses have not always been reflected as a part of the PR&U, although if the pricing and reserve measurement objectives include reflection of all related cash flows, a PR&U with respect to expenses would be included. In addition, particularly for older blocks where claim activities dominate, fixed costs will be an increasingly large part of total expenses so that volatility in claims will also affect unit expenses.

- **Business/management risks**

  Business risks include exposure to loss of value due to changes in the volume and mix of new business and run-off of existing business, ineffective underwriting or claim management, and guarantees created by product design not matched by invested assets. Some of this risk may be considered consistent with expense, asset/liability mismatch or operational risks. Business risks relating to the development of new business are generally not considered in the measurement of inforce premiums or reserves.

  Management risk is usually considered part of the range of operational risks. Insufficient investment or use/allocation of appropriate resources with adequate LTCi experience can add to the uncertainty regarding whether expectations are achievable. New management without LTCi experience may struggle to handle the intricacies of needed LTCi management action. In a closed-block of business situation, talent drain can affect successful management of a run-off environment, with common adverse effects of loss of institutional memory. In addition, management regimes usually last for a much shorter time period than the coverage period would benefit from, reducing the effectiveness of necessary feedback loops.

- **Operational risks**

  For practical purposes, operational (e.g., fraud, processing and control failure, systems failure, litigation, regulatory breach, fraud, brand and broad environmental) risks are usually considered non-diversifiable. These risks have usually not been recognized in premiums or reserves and have generally been addressed by the insurer's risk capital. This treatment can be justified on the basis that they are very difficult to quantify, are insurer- rather than policy-related risks, and without explicit guidance they could be a source of significant inconsistency in PR&Us between insurers. In a cost of capital approach, an implicit provision for operational risk might be provided for on an overall basis in the PR&U. Emerging practice in a few countries, such as Australia, is to include a provision for this risk in PR&Us for reserves, although the range of risks that might be included in this category is quite wide.

  In addition to the general operational risks associated with other insurance products, LTCi claim payment procedures are very susceptible to reputation and litigation risks. For example, some

LTC insurers have loosened certain claims payment rules for fear of potentially bad publicity resulting from not paying benefits for the elderly. This additional risk can lead to significantly different experience among insurers, depending upon the companies' claim philosophy.

There is no standard approach to reflect these risks, possibly considered Knightian or pure uncertainty ("unknown unknowns") factors—those that not only cannot be measured precisely, but in some cases cannot even be described. For example, these could include unanticipated future types or business models of LTCi providers required to be covered that were not anticipated and changes in law/regulation that could affect eligibility for or eligible benefits. The long time period between policy inception and payable benefits could lead to expectations of costs that are quite different than actual costs.

- **Relationship between risks**

  Recognition and quantification of the effect of correlation between LTCi experience elements represent significant challenges in the application of any method of providing for risk and uncertainty, but most obviously in methods that reflect risk and uncertainty of individual assumptions explicitly. If the effect of correlation is significant, approaches to reflect it include: (1) explicitly calculate a correlation matrix among variables and (2) take a haircut of the total of the PR&U relating to the individual assumptions (such as only reflecting 60 percent of the sum of the effect of the individual risk components or taking the square root of the sum of the squares of the individual provisions).

  One of the most significant challenges involved is the estimation of the correlation between the individual sources of risk. For example, as LTCi claim incidence rates increases, claim termination rates consequently tend to increase (e.g., home health care services may be more frequent, shorter in duration, and less regular, with more frequent apparent recoveries than institutional services, in part because they tend to be initiated at an earlier age and tend to be subject to more policyholder choice); repeated rate increases can lead to a higher rate of claim for those who remain covered; a sudden shift in economic conditions can affect investment earnings and reluctance to go to claim; and a gradual shift in types of claims and providers. Not all of these may be amenable to insurer mitigation efforts.

  Nevertheless, it should be recognized that any basis for correlation is to some extent arbitrary due to the complexity and long-term nature of LTCi coverage. A top-down approach, that is, one that starts from the aggregate risk level, also has to reflect correlation, although in an aggregate manner. Reflection of this aggregation in an implicit or approximate manner, that is, by an overall factor or adjustment, has been used in many cases, although it is normally a practical rather than theoretically derived approach.

  A more refined model will tend to be more responsive to several of these shifts. This correlation is one reason why some accounting systems are moving toward an aggregate reflection of risks.

However, such a model also can encourage a false sense of confidence, the belief that all factors have been reflected, even though there remain a substantial possibility that over the long-term not all such factors have been identified.

Future LTCi risks and uncertainties

Just as significant changes in conditions and increases in understanding of some of the drivers of past experience have occurred, there are many additional possible scenarios and considerations, both adverse and favorable, that insurers should consider in setting future assumptions and designing new products. The following are several examples of new or possibly unanticipated risks or changes in conditions that may affect LTCi in the future:

1. A significant legislation or court decision with a pervasive effect on LTCi benefits, costs or premiums, especially of a retroactive manner; for example, a change in a government program that could eliminate or drastically reduce the need for private LTCi or significantly curtail the availability of Medicaid reimbursement for nursing home care;
2. A new provider type or care setting becomes covered by current policy features;
3. A change in the business model or standards of practice of nursing homes, ALFs (for example, being primarily used for residential rather than medical care by taking all-comers including at least one 2+ ADL family member) or broader coverage for home care;
4. A change in the types of firms providing LTC services or a significant increase in minimum wages for home health aides, with imported labor becoming more dominant because of ease of becoming a qualified home health aide;
5. A regulator or court interpretation requires benefits (especially facilities that are deemed to be nursing facilities or ALFs) not currently contemplated;
6. Family conditions change, for example, fewer daughters who in the past provided significant home elder care, may be available or willing to provide such care; in addition, fewer children may result in greater use of provider care, whether or not current policyholders' health conditions are as bad as claimants used to be;
7. The younger population cohort, because of different physical conditions or attitudes, use LTC benefits in a very different way from the older generation whose experience is included in LTCi experience analysis;
8. Unexpected effects of changes in underwriting rules or from personal risk characteristics, e.g., fewer smokers or greater obesity, on use of LTC services;
9. A sudden permanent shift in mortality, lapse or claim continuation;
10. A break-through in the treatment of a relevant medical condition, such as Alzheimer's Disease, enhancements in technological delivery of care services, or in contrast, severe adverse long-term effects might arise as a result of a currently unrecognized condition, such as exposure to cell phone radiation;
11. A management decision to get more strict /(lenient) on claims management procedures so that future claims experience differ from experience data earlier gathered; and

12. A structural shift in economic or demographic conditions, such as a prolonged recession that forces the elderly to seek secondary retirement income from LTCi, which can have subtle or not so subtle effects on claim utilization on either a temporary or permanent basis.

For assessment of an inforce block of business, some insurers may not already have fully adjusted for changes in conditions in their renewal premium or reserve calculations, including the following:

- Continued low or even lower voluntary lapse rates;
- Continued active life mortality improvement;
- Continued increased use of ALFs;
- Continued or increased use of waiver of premium feature to avoid continuing payment of high LTCi premiums;
- Underestimate of expenses for a declining block of business; and
- Current and possibly continuing low interest rate environment.

New Business Considerations

As LTCi actuaries have obtained more relevant experience, smaller mispricing risk may be emerging, with a corresponding need for a reduced PR&U for future new and renewal business. The degree of usefulness of that available experience information for application to that or similar blocks of LTCi policies depends on the amount and relevancy of that experience.

For a block of new business, the following are observations about possible changes in uncertainties relative to the level of PR&U that may be considered relating to selected key elements of experience. Please note, however, that issues and uncertainties associated with the application of available experience discussed in the succeeding list in this section should also be considered in determining the extent that the PR&U might be reduced for a particular block of LTCi business.

- **Claims**. Insured claim experience for immature or mature business should be expected to be different than general population prevalence experience[xii]. An overall trend in the general population (cohort-related), unlike relevant insured data, may not be relevant to insured experience, because of several factors, including different population segments covered due to market segment and underwriting applied, policy features, and the very existence of the insurance mechanism that provides different incentives to use LTCi covered services. The larger the relevant available experience base, the less uncertainty exists, and thus the smaller the PR&U needs relative to the level of expected future experience. However, experience may not be available for ultimate rates, especially those at older ages and later policy durations; thus the portion of the PR&U that relate to those ages and durations may not decrease. In addition, a trend risk remains in any case.

- **Active life deaths**. If the model used is a claims cost model (in contrast with a first principles model in which claim incidence rates are based only on inforce lives not currently on claim), a

bias associated with the percent of inforce policies on claim can arise (i.e., if the percent of total inforce on claim differs from expectation, the mortality rates would be applied to a biased exposure base; a similar bias could exist for claim incidence as well). Again, in any case, the greater the amount of relevant experience, the amount of PR&U is reduced accordingly.

- **Benefit utilization**. Although uncertainties will continue to exist relative to the effect of benefit inflation increases and corresponding provider charge increases associated with the level of benefit utilization, prior experience should reduce its associated uncertainty and PR&U.

- **Benefit continuance**. As is the case for other sources of uncertainty, the component of the PR&U associated with benefit continuance (either due to death or recovery) should reduce over time, although because a claim has to occur prior to experience data being available, the credibility of such experience may be smaller, especially at older ages and later claim durations.

- **Voluntary terminations** (lapse). Many insurers are experiencing ultimate annual lapse rates (that is, after a select period of higher lapse rates in the first five to ten years) between 0.5% and 1.0%. Although these rates may increase somewhat, it is unlikely that they will decrease much further and thus will reduce the amount of the PR&U.

- **Asset related** (interest rates). At the time this paper was written, market interest rates are at historically low level. Although a low long-term Japanese-type interest rate scenario is possible, a more likely future long-term investment scenario would have fixed investment returns greater than those currently available.

- **Regulatory actions**. While expected future rate increases would not normally be reflected in the anticipated costs of newly-priced business, possible regulatory action could to some extent reduce the effects of uncertainty associated with adverse experience, although the risks associated with not being permitted timely and needed rate action would also be considered in determining the level of PR&U.

- **Expenses**. Although uncertainty associated with future unit expense experience will likely continue (for example, relating to a possible change in a TPA or its fees occur or if the insurer's target market changes), unless per unit expenses have or are expected to change significantly or prospects for per unit inflation risk is different than under prior conditions, in many cases unit expense risk will tend to remain level (or possibly decrease once LTCi operating and claims operations have been established).

Interpretation of worse than expected experience

A significant challenge to the insurer arises when LTCi experience is worse than expected. It may be especially difficult to identify what the key driver(s) is of the deviation, including whether the losses were driven by claims processes, changes associated claim backlogs or whether due to temporary or

permanent one-time changes or a continuing trend compared with initial expectations. Obviously a deeper understanding of such a condition is important for all LTCi stakeholders, including:

- pricing actuaries who set or recommend prices for new business or decide whether to file for a rate change for existing business;
- regulators who review rate changes;
- valuation actuaries who set or recommend financial reporting assumptions;
- insurer management who have to decide or are otherwise affected by actuarial, regulator or other management decisions; and
- investors who are affected by current and anticipated income generated by LTCi insurers.

Aggregate benchmarks used in any such assessment include trends in sales, income, persistency, claim incidence, claim severity and claim continuance, all as affected by underlying probabilities. Specific benchmarks are usually based on either budgeted values over a short-term period or long-term pricing or valuation expectations.

The first step in any analysis of volatility is to assess whether such emerging experience is temporary or permanent. This early assessment is usually for the use of internal management. Often this assessment requires some patience, as short-term fluctuations will inevitably occur, even in the very largest portfolios of policies or claims. Temporary fluctuations can, of course, be the result of inaccurate or lagged data reporting, dramatically changed economic conditions, or statistical fluctuations / pure process risk, but also because of claim backlogs, or local events if there is a change in concentration of risks in a particular jurisdiction, area or type of provider used. Analysis of concentration of the source of the emerging experience can provide insight. If not significant (yet), such a temporary deviation might prove to be an early warning of an emerging permanent problem, which would be a focus for a later follow-up or thorough experience analysis study. Although reports showing rolling period (for example, for five years) data represents a more credible base for trend analysis, it may prove deceptive if recent experience within that period is not studied in more depth).

If it is determined not to be temporary, then the question of whether the cause is due to adverse experience that is expected to continue, to expectations (benchmarks) that have proven to be inaccurate (sometimes referred to as assumption miss-specification), or a change in the mix of exposures or claims in a category for whose experience assumptions were developed on a broad basis. In some cases, mitigation techniques or management action (such as communication that stricter adherence to policy provisions is to be made if liberal claims management was a source of the deviation or a reduction in dividends / seeking rate action) might counter or offset such a deviation. An assessment as to the scope and severity of the deviation would be the next step taken, in many LTCi cases made difficult because of the very long coverage, low claim rates for many early policy years and long claim period.

The following are several possible areas to determine where to focus attention on:

- **Period versus cohort changes**. What may seem at first to be economic-driven or changes in experience by provider type might prove to be a period effect, rather than an aggregate period effect. A cohort effect might be related to different underwriting standards or product features in effect by issue year. Different assumptions by cohorts of issues would be appropriate if this proves to be the case.

- **Recent versus earlier cohorts**. If an experience shift arises, the PR&U would be greater for more recent experience (for the more immature block of business) for which emerging experience may be too early to rely upon and experience of older business may not be relevant.

- **Trend versus discontinuity**. Without an adequately long study period, it can be difficult to discern the difference between a change in experience that is expected to be a one-time fluctuation, experience that will continue at the new level, or experience that continues along a trend line. Fitting experience might provide some clues, but may not be definitive. As always, it is useful to understand the source of the change, for example, the move toward more use of ALFs (rather than nursing homes) might be a continuing trend for a certain period to a maximum level based on judgment.

- **Select versus ultimate**. In particular, fitting lapse, active life mortality and claim incidence rate experience during early policy years (and likewise for rates of disabled life termination and utilization based on claim duration) may be quite different than ultimate rates for those assumptions. The time until an ultimate level is achieved and what the ultimate rate(s) will be may be quite problematic unless relevant experience and an understanding of the underlying experience becomes available. Experience for early policy durations can usually be fitted relatively easily, but the ultimate period and level is usually difficult to estimate.

- **Recent experience versus all experience to date**. A tension usually exists between the use of credibility (size of data) and relevance (usually more recent) of data. The principle of relevancy often trumps quantity of data—primarily because the conditions from which older data is obtained may be too far removed from the projection period to be relevant, especially if the policies were underwritten differently, if different product features than the block of business evaluated, or if different provider mix are likely to lead to different experience. Nevertheless, it may be dangerous to ignore gradually changing long-term trends in experience.

- **Jurisdiction**. State regulators are naturally concerned with experience in their jurisdiction. Unfortunately, except for the large insurers in the largest states, it is unlikely that an insurer would have sufficiently statistically credible experience to make definitive use of an individual state's experience. Possible alternative measurement approaches (to the use of nationwide experience) include credibility weighting the state's experience with credibility's complement being nationwide experience and use of regional groupings or ones with similar experience

(along with credibility weighting) might be used instead. This focus on differences between jurisdictions has expanded as the levels of rate increases granted have varied across states, leading to highly unequal premiums being charged individuals for the same coverage. Most state regulators have, however, accepted nationwide experience, unless state experience is demonstrably worse than the average.

It is then useful to compare, based on relevant insured and policy characteristics, assumptions to actual or emerging experience. To the extent that a significant difference in actual to expected experience becomes apparent (and after any appropriate adjustments are made), it would then be appropriate to adjust previous expectations to base future projections. It is important to note that it is appropriate to assess differences in both base expectations and in the variations of experience that form the basis for a PR&U, the latter of which may decrease over time, especially if emerging experience has reduced the amount of uncertainty associated with the estimation of future experience (although this is not always the case).

In reviewing the size of the PR&U, particularly in preparation or assessment of a rate increase filing, it may be appropriate to determine how much statistical or professional confidence the preparer of the filing has in its support. If for example, a 10 percent PR&U expressed in terms of policy-long claim costs is used as a base case margin, then a variation higher or lower than that level might be based on the relative immaturity of the block considered or remaining uncertainty associated with experience of the block of business (or extent of insurer experience with similar policies).

Conclusion

As can be seen from the nature of the above categories of experience and corresponding risks, there is significantly more short- and long-term volatility in LTCi than in many other insurance products. This volatility can arise from many factors, including policyholder incentives and behavior, changes in societal care giving and demographics, dynamic characteristics and mix of providers likely to be accelerated due to the influx in future claims from the baby boom generation, differences in claim processes and markets between companies, and general insured health status, in spite of guaranteed renewal premium options. The risk is not only inherent in all of the factors that drive experience underlying LTCi, but also in the design of the product itself.

Most other insurance products that incorporate this amount of risk associated with policyholder behavior, such as traditional health insurance, have significantly shorter coverage periods that allow the price that insurers charge to respond to experience shortly after it happens. Alternatively, insurance products with a similar long duration, such as life insurance, have significant cash surrender values that enable policyholders to voluntarily terminate their coverage without losing all of their built-up equity. These differences greatly affect the risk borne by the LTC insurer, which contributes to making LTCi more risky, estimates more uncertain, and experience more volatile.

Due to the subjective nature of qualifying conditions, steep cost curve, high persistency, and the long-term nature of the uncertainties of the frequency and severity of claims, the primary way in which insurers can offer LTCi at an affordable price that is at the same time profitable is to design products that share the risk and align the interests of insureds and insurers, as noted in the "Mitigation" section of this paper.

Identifying the extent that reported adverse (compared to expectations) experience has been due to the inherent volatility in the business, or incorrect assumptions is quite challenging, given the amount of judgment required in setting assumptions and assessment of experience. The key to identifying the underlying drivers involved is to have both a refined set of expectations (benchmarks) and timely and detailed reporting that measures the differences between actual and expected experience. As noted in Loomis et al. (2014), volatility ranges can be set around these expectations that trigger further analysis and a review of the basis for determining appropriate actions. Systematic monitoring can provide insurers information for use in new product development and pricing feedback loops, as well as to provide relevant information to State Insurance Departments in any needed rate increase filings.

Going back to the questions raised in the Introduction to this paper, reflecting the discussions in this paper:

› How risky is a typical LTCi block of business?

The future experience of LTCi will always carry a significant amount of demographic (including morbidity, mortality and policyholder behavior) and economic (including interest rate) uncertainty. Because of lack of relevant experience related to some of the key experience elements of LTCi, its steep cost curve and long-term nature, there was a significant under-estimation of its uncertainty during the first decades of availability of LTCi. In fact, recent adverse differences in actual-to-expected experience in many areas have confirmed this uncertainty. However, the implementation of key mitigation strategies, discussed in the "Mitigation" section of this paper, together with relevant and credible recent experience, should reduce the level of uncertainty for LTCi in the future.

› How are these risks exacerbated by product design and how can they be mitigated by product design modifications?

As indicated in the "Mitigation" section of this paper, the ultra-low LTCi lapse rates indicate policyholders' expected need for LTC benefits. This points to the need to make the interests of the LTC insurer and its policyholders through product design as consistent as practical. Nevertheless, the subjective nature and enhanced use of non-nursing home benefits will continue to make this a challenging line of business to manage.

› How can an actuary differentiate between poor experience due to inherent volatility in the underlying LTCi business and poor experience due to incorrect assumptions?

As indicated in the "LTCi and volatility" section of this paper, volatility can arise due to numerous currently known and it should be expected to be some unknown causes. It is most important for the actuary to understand the sources of this volatility—for example, whether

they are caused by short-term shocks, such as a sudden change in claim backlog or biased expectations, or alternatively structural changes in conditions. There are many ways of analysis of adverse financial results, but one of the best is the development and regular review of expectations (whether they be pricing or reserving assumptions or quantitative benchmarks or qualitative indications of industry or economic trends). Part of this is proper assessment of long-term trends, enhanced by consistent and high quality data, management reporting and experience analysis information should also help. Actuarial feedback loops and regular in-depth communication with operating staff will assist in developing this information.

› What implications does this have for pricing margins and triggers for rate increases?

As discussed in the Appendix to this paper, pricing margins (referred to in this paper as PR&Us) should reflect an appropriate amount of uncertainty, sometimes referred to as representing moderately adverse outcomes. As indicated in the "Methods of quantification of risk and uncertainty" section of this paper, there is no single conceptual method for determining a PR&U, although several methods and approaches to determining a PR&U are discussed in that section. Rate increase triggers require assurance that volatility and adverse deviations from expected used as a basis for the determination of rate increases are not based on temporary blips in experience and represent sound indications that the source(s) of these deviations are understood and quantified.

While experience volume and maturity for the LTCi industry and larger individual insurers has become more credible in recent years, there is still a need for a consistent basis for development of assumptions and expectations across the industry. Publically available inter-company experience studies that aggregate experience at a granular level, such as the one being sponsored by the SOA Long-Term Care Section Council, will assist in the effort to develop consistent benchmarks for key LTCi parameters. The current and future development of these parameters will further enable actuaries, insurers and State regulators to more comprehensively assess the implications of experience and income volatility of this business and to differentiate it from incorrect experience assumptions or changes in underlying experience.

6. Appendix:

Reasons for a provision for risk and uncertainty

Before discussing methods for deriving a provision for risk and uncertainty (PR&U) and assessing volatility, it is important to confirm that an explicit provision in premiums and reserves is appropriate for this purpose. To that end, the following are reasons why an explicit PR&U should be included in premiums (note that the same reasons apply to such a provision in reported reserves for insurance policies):

1. Policyholder protection;
2. The price for bearing risk based on the market; and
3. The cost of bearing risk.

If actuaries were able to (1) derive perfect assumptions regarding the future based on current conditions, (2) immediately identify the sources of deviations from prior expectations (volatility), and (3) immediately change rate levels to correspond with changes in expectations, there would be no need for a PR&U. However, none of these conditions are met in practice. As a result, it is appropriate to include such a provision in premiums. The following discusses the objectives of a PR&U.

The objectives of a PR&U

Whether a PR&U is derived to reflect a specific level of risk, or is applied as a more or less arbitrary manner addition to the current estimate of the net obligations to policyholders, it is important to formulate its objectives as clearly as possible.

In discussing these objectives, it is useful to understand the context in which they apply, that is, the nature of the insurance policies and the standards underlying their application, e.g., in premiums or reserves. In general, the insurer agrees through an insurance policy and its features to provide, in exchange for the expected payment of one or more premiums, a set of benefits and options to a beneficiary or service provider upon occurrence of specified contingent events affecting the lives or property insured. Each of these future events involves uncertainties, even when insurance pooling is applied.

Two fundamental viewpoints regarding such a policy can be distinguished:

1. Policyholder view. Policyholders are subject to adverse financial consequences of risks as to the frequency, timing and/or severity of covered contingent conditions that they cannot or do not wish to bear themselves, and are provided certain options within their policies to deal with these consequences, considering their own assessment of the cost and benefits of transferring those risks. Particularly because of their long-term nature, policyholders rely upon the promises

made by the insurer to be assured that these consequences will be fulfilled. For LTCi, a PR&U also reduces the frequency and size of possible future rate increases.

2. Insurer view. The insurer manages the risks and uncertainties involved by means of one or more risk management techniques, including the pooling of similar risk exposures, making use of flexible policy features, diversifying these risks across multiple risk pools, reinsuring or securitizing the risks, and investing pre-paid funds to reduce the level of premiums. The mitigation potential of possible rate changes also can enhance the incentives for insurers to offer LTCi. Nevertheless, uncertainties remain with respect to the contingencies involved, as these techniques cannot completely eliminate their financial effects.

Whichever viewpoint is taken, the ultimate financial effects of the insurance obligations will, by their nature, remain uncertain for what may be a significant period of time. The pricing actuary and the regulator are both concerned that insureds receive a fairly priced policy that provides for a high likelihood that promises made will be fulfilled and that policyholders will be treated equitably and not be overcharged.

For the bearer of an insurance obligation, there is a cost associated with covering the risks of providing these obligations for which a return should be expected that may be quantified in terms of a market approach, expressed in terms of a market[xiii] price for fulfilling them or by actuarial estimation of the costs to the insurer, representing the same concept looked at from different perspectives – the bearer of the obligation and a relevant marketplace participant.

The following discusses these perspectives.

Policyholder protection

Ensuring that the promises made by an insurer to its policyholders will be kept is a primary objective of the insurance regulatory function. To that end, acceptable methods and, to some extent, the assumptions by which rights and obligations are valued for pricing and reserving purposes, can be subject to regulatory rules and review, as is the amount of capital that an insurer needs to remain in business. Over time, the type and extent of the authority available to regulators have evolved with respect to the use of methods and assumptions or premium development and the amounts and approaches to reserves and required capital.

To satisfy their objectives, regulators usually prescribe that rights and obligations must be valued on a conservative basis that covers moderately adverse deviations from their expected net cash flows. The amount of capital required by the regulatory function represents an additional provision, which serves as a second level of protection to cover more adverse outcomes.

Regulators require and policyholders ultimately benefit from an adequate level of premiums, reserves and capital that ensure that total resources of insurers are sufficient to cover obligations to policyholders with a high level of confidence that the insurance promises made will be kept. Although the quantitative distinction between PR&Us and capital can appear somewhat arbitrary, the principles underlying their aggregate amount is reasonably clear. For solvency assessment purposes, the focus on the delivery of promises under extreme circumstances has recently tended toward the use of a total balance sheet approach that reflects the combined effect of reserves and capital. For this purpose, if PR&Us were higher (or lower), the required capital would be correspondingly lower (or higher).

In contrast, the level of premiums and reserves should be adequate to cover moderately adverse circumstances, sufficient to enable mitigation approaches, such as premium re-rating, to become effective, with company capital being available as a financial backstop for the entire company's obligations.

In order to be convinced to buy and then keep the policy inforce until its benefits are needed, the policyholder needs to be convinced that both the insurance promises made in the policy will be satisfied and that the premiums charged are actuarially fair (that is, consistent with expected costs), while at the same time are reasonably competitive with other comparably sound insurers.

The price for bearing risk based on the market

The market approach represents a current exit value for a portfolio of insurance policies, the amount that a third party would expect to receive to transfer its policy rights and obligations to another insurer, including the risks and uncertainties involved in satisfying the policies' obligations. It is unlikely, except in certain reinsurance policies, to actually transfer a specific risk of a policy, and even then only certain elements, although it may be conceptually useful to discuss this.

Where a deep and liquid market for a class of insurance obligations exists, a reasonable exit value (corresponding to a price) would be observable under most circumstances. The exit value determined from these price observations would implicitly include a PR&U, reflecting the current market view for the price for bearing the risk associated with the insurance policies. Alternatively, such a price can be viewed as representing the corresponding reward or compensation for bearing risk by the insurer from the perspective of market participants.

In some cases the financial component of the cash flows can be hedged. However, there are aspects of LTCi that certainly cannot be, as there is a limited current market for LTCi risks and for assets of a duration greater than, say, 30 years, or a larger market for certain catastrophe risks--but these exceptions do not affect the non-hedgeable nature of most of the insurance risks involved. For the risks that can be replicated by financial instruments (e.g., the investment risk through securities and derivatives), it would be possible to refer to market prices for similar cash flows for measurement purposes. A market price includes both a current estimate of expected discounted cash flows and a

PR&U in excess of that amount; it should be noted that in assessing a market price it is not usually possible to separately identify these components.

A market for LTCi risks such as morbidity, mortality, or policyholder behavior has not developed and may never exist. Such risks can therefore be considered non-hedgeable. This is not necessarily a characteristic of the risk, but rather represents the absence or characteristics of a market in which such risks could be actively traded. The use of a three-block model (current estimate of future cash flows, a discount reflecting the time value of money and a PR&U) assumes that, under normal circumstances, a transferee would require an amount greater than the current best estimate basis (even if the transferor and transferee were to exactly agree on the level of the current estimate). Otherwise, the transferee would not receive any compensation for taking on the risk that everything does not work out as expected, which is not realistic. The PR&U can therefore be regarded as compensation for taking on the additional amount related to the uncertain expected financial return from the LTCi policy.

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

Under this view, the PR&U could be estimated by incorporating knowledge or judgment as to what a rational market participant in the transfer market would require at the time the measurement is made. Although it is arguable whether a competitive market exists in LTCi today (either among direct writers or in a risk transfer market), because of the relatively high price for coverage, especially at the older issue ages where the need for this coverage is more apparent, it could be claimed that new sales are price sensitive, with the resulting margin that could be interpreted as being consumer market-based, rather than competitive or transfer market-based.

The cost for bearing risk

Unlike the price or exit view, the basis for the PR&U is determined according to the insurer's expected cost of bearing risk. Because, by law or regulation, the obligations inherent in insurance policies have to be borne by an insurer required to hold a minimum amount of regulatory capital, it is common practice

in the insurance industry to describe risk in the context of the capital needed to bear it. The financial cost of maintaining this required capital is a necessary cost of operating such a business.

This required capital is not necessarily determined on a purely economic assessment of risk. Consequently, to operate such a business on an economically sound manner, the cost might be better viewed in terms of the insurer's economic capital (the amount of funds in addition to the amount of the insurer's premiums and reserves deemed necessary to effectively manage the risks associated with the business). An appropriate level of economic capital could be based on the insurer's level of risk aversion and its desired agency rating level and market share. As a convenient metric, this has sometimes been determined as a solved-for multiple of the level of required regulatory capital as a convenient metric.

Alternatively, depending on the application (e.g., for U.S. LTCi regulatory purposes), the cost of risk and uncertainty could be based on the general principle of providing for moderately adverse conditions, which would be somewhat less than full cost of economic capital.

Relationship between these PR&U views

The policyholder protection, price and cost perspectives are clearly related, but viewed from different perspectives and objectives. From the policyholder protection viewpoint, the PR&U enhances the ability of the insurer to absorb a reasonable degree of adverse experience related to its rights and obligations, and thus the likelihood that promised benefits will be paid—although this is at the cost of higher premiums. In addition, policyholders desire premium predictably, especially since LTCi policyholders may be of older ages, possibly retired on a fixed income. To the extent the PR&U proves insufficient to provide for subsequent experience, profitability and in the extreme case solvency will prove to be at risk. If the business is sold or transferred to another party, the price for a transfer of a set of insurance risks will include the transferee's view of the risks and uncertainties borne to another insurer in a risk/reward tradeoff, while if the business remains with the current insurer, there is a cost associated with bearing the risks and uncertainties involved.

If experience during a period is at least as favorable as that assumed at the beginning of the period plus the PR&U, the release of the PR&U generates a profit during that period that serves as a potential reward for the investor that has taken on the risks involved. If experience is worse than assumed by less than the expected PR&U release, some of that expected release is absorbed and a smaller profit emerges. If the actual experience is worse still, the reported loss is partly offset by the expected release of the PR&U. In the long run, the whole of the PR&U is available to cover adverse deviations from process, parameter, or model risks.

This is the same view as an investor would take, as the PR&U defines the expected reward for providing for deviations from the expected costs, that is, this provision represents the value of the price for bearing the risks and uncertainties involved. The cost of bearing risks perspective assesses the overall effect of measures taken consistent with business needs, including making adequate capital available to

cover the risks and uncertainties involved. In addition, the same perspective can be taken by the regulator if an arrangement is needed to wind down or sell the obligations of a failed insurer.

At first glance, it may appear that differences might exist between the insurer's perspective, which reflects an entity-specific view of the assessment of the risks inherent in the policy's obligations, and that of the investor, which is based on more of a market consensus view. In particular, the entity-specific view of an adequate level of PR&U might not be consistent with the level of the investor's risk aversion. However, for most of the risks addressed here (i.e., the non-hedgeable risks such as morbidity, mortality, expenses, and policyholder behavior risks), it can be assumed that entity-specific and market views are not quantifiably different. This is because both market- and entity-specific assessments of risk considers the specific characteristics of the policies and claims, with differences due to variations in the underwriting and demographic characteristics of the insureds, and claims management practices (although market participants might, for example, think that tighter claims management practices are desirable). Therefore, if applied appropriately, both views result in a similar assessment of the underlying non-hedgeable risks, although they may result in exactly the same amount.

Any party subject to the policy risks involved needs to demonstrate its ability to cover losses from its resources and hold an appropriate level of capital for this purpose. The PR&U would then represent the expected price for providing that capital or an equivalent economic guarantee, which in turn equals the price a market participant would require for taking on the risk. This presumes that prices would reflect the effect of mitigation, even though each participant might make use of or have available different mitigation approaches (see the "Mitigation" section of this paper). In summary, the outcome does not depend on the view taken.

Therefore the regulator's, policyholder's, insurer's and market's degree of risk aversion are by necessity reasonably consistent. From the PR&U perspective, a transferee would need to settle the obligations in a manner reasonably consistent with how the transferor would have been obliged to do. The exit value view also addresses uncertainty consistent with the settlement of the obligations by the transferor. Although data with respect to market consistency and the investors' views are not usually available relative to their expectations and risk preference, they are concerned that a decent return on economic capital becomes available, while the concepts and needs for a PR&U are equally relevant to be provided in premium levels for LTCi. Their concerns for solvency, reporting and consumer protection are provided through regulators' rules and risk-oriented objectives, recognizing that policyholder protection and a minimum solvency comfort must be provided for in premiums and in applicable reserve transfer, if needed, for the entire company through capital to satisfy all its obligations under extreme circumstances.

7. Glossary of statistical and risk/uncertainty concepts

The following definitions and description of specialized concepts and terms may be helpful to understand and evaluate the aspects of risk, uncertainty, and volatility covered in this paper.

- **Best estimate**. The selected estimate of future cash flows that does not include a PR&U. Although it has also been referred to as the expected value or actuarial central estimate, it may not strictly be the result of the application of a statistical distribution, but might also reflect subjective views or be determined based on a combination of several methods.

- **Coefficient of variation** (CV)**.** The risk level (usually expressed as a multiple of the distribution's standard deviation divided by the mean value). This indicates a relative degree of possible variations in outcomes. The relative width of a risk distribution can be described by its CV. This metric is useful because a standard deviation of 1 million is small if the mean is 100 million, but large if the mean is 500,000. The CV is 1% in the first case and 200% in the second case.

- **Concentration risk.** Risk concentration exists when a large percentage of an insurer's risks (e.g., coverage, market segment, geographic area of insureds or assets, and asset types, for example, in a single industry) is in a certain category of exposures.

- **Cost of capital method**. The cost of capital refers to the amount of return demanded by the marketplace on an investment of economic capital from an insurer to enable its obligations to be satisfied after payment of income tax.

  The cost of capital method is used to set profit margins in premium rates in many markets and, in a simplified form, is also used for reporting embedded values for life insurance. It reflects the concept of a PR&U as the price of bearing risk.

  To apply the cost of capital method, the applicable capital and its cost at the measurement date and at each subsequent period during the runoff of the obligations would be reflected. To estimate the required capital amounts, the expected cash flows are estimated for each future period until the claim/policy obligations are settled.

  For example, ignoring taxes, if the total required return for a transferee is 12% and the return on investments backing capital is expected to be 7%, then the cost of capital would be 5%. If corporate income tax were 20%, a pre-tax return of 15% would be required to achieve the 12% after tax return ((1.0 - .8) * .15 = .12) and the cost of capital would be 8%.

  In an example application of this method, the value of 6% is used in the Swiss Solvency Test for a capital level described as a 99.5% confidence level (i.e., capital determined using the quantile approach) and is described as approximating a BBB financial rating. A value of 4% has been used in various industry presentations as applicable to insurers with capital at a 99.95% confidence level described as approximating an AA financial rating level.

The cost of capital does not refer to the firm's cost of capital, but rather to the relevant (e.g., a reference insurer's or capital market participants') market's requirement for return on the capital needed for the non-hedgeable risks. It can be determined in a number of ways, including (1) judgment for testing purposes, (2) analysis of historical returns on book value, (3) market value analysis, and (4) analysis and testing.

The cost of capital for application in a PR&U might not be the same as the after-tax return on market value sometimes determined from methods such as CAPM. This is because the market cost of capital must be adjusted to produce values that do not reflect the firm's cost of capital and its franchise value (market value minus reported capital in the financial statement, including the value associated with future blocks of business). The cost of capital may vary by coverage, risk classification, and perceived level of risk.

Although equity, reported capital and regulatory capital may be available from existing financial reports, that information is not directly used in the cost of capital method. Regulatory capital and reported capital relate to all of the insurer's risks and strategic choices. For the purpose of a PR&U, the capital level deals with only policy-related risks and not with all of the risks associated with the ongoing insurer. Even information on capital for runoff insurers may not be relevant, as they are few in number and their situations usually have unique characteristics that make application to the "normal" situation problematic. Further, at a given time, available capital is typically either higher or lower than economic capital, since economic capital is a moving target and an unobservable theoretical concept.

The cost of capital method requires models to measure the capital in a manner that is economically sound (i.e., sufficiently risk sensitive). Current practice is to determine economic capital determined as a quantile value, although the capital determined by a quantile method may not reflect all the features of the risk distribution that might affect the PR&U.

- **Discount rate method.** A risk adjusted discount rate method discounts expected cash flows using risk-free interest rates minus a selected PR&U. The discount rate might vary by line of business, age of runoff or other factors that affect the risk distribution.

  One method assumes that the PR&U discount rate equals the effective risk-free rate (or other appropriate unadjusted discount rate, thus using undiscounted, non-risk adjusted values). In that case, there is no discount rate applied to the measurement of the premium or reserve, as applicable. This is the method used for most U.S. GAAP and regulatory reporting of claim reserves for property & casualty insurance in the U.S. and some other jurisdictions. It should be noted that PR&Us, under this approach, vary according to the general level of interest rates that in many cases has little to do with insurance risk.

- **Diversification**. Diversification is a mitigation technique that involves a combination of risks, aggregating risks that are less than 100% interdependent.

  Using a market-consistent valuation methodology, premiums or reserves would be calibrated based on assumptions regarding the level of diversification of the relevant risk factors. These factors are consistent with those expected to be made by market participants in assessing the value of the portfolio. For example, in the case of underwriting risk, this would correspond to the level of concentration of risk that can be absorbed by the market at zero or nominal cost. Nevertheless, a residual market level of volatility may remain that cannot be absorbed in the market at zero cost.

  Severe financial incidents can affect the correlation between risks that are normally independent. For example, normally, market risk and morbidity risk are independent. However, a severe pandemic like the Spanish flu of 1918-19 that would result in millions of deaths affecting both policyholders and caregivers, would affect several demographic and financial factors. In practice, when several distributions are combined, dependency in their tails is likely to be greater than nearer the means of their distributions.

  If the use of a "standard" correlation matrix fails to handle this type of situation, copula functions can be used. The use of copulas is a theoretically proper method to calculate diversification effects in the context of PR&Us and required capital. In general, the use of a standard correlation matrix is inappropriate because correlation coefficients normally reflect average correlation over a range of possible outcomes, while PR&Us are more concerned with unfavorable outcomes when dependencies are often atypical. An advantage of the use of copulas is that they can be used to accurately combine distributions that are not from the normal distribution family. They can also recognize dependencies that change in the tail of the distributions used, for example by the use of a T-Copula.

  However, copula functions can be rather complex to apply, particularly if a large number of distributions have to be combined. A more practical method can be to adjust the correlation matrix in such a way that, for a confidence level normally dealt with, the combined distribution results will be reasonably correct. The adjusted correlation factors are referred to as "tail-correlations".

- **Economic capital**. The amount of funds, in addition to the amount of an insurer's premiums and reserves, deemed necessary to efficiently manage the risks and uncertainties associated with the business.

- **Expected policyholder deficit** (EPD). The EPD is usually expressed as a percentage of the expected cost of claims. A way of expressing this is in terms of percent of the monetary amount of payout (100% – EPD%). A 1% EPD means that claimants are on average, expected to receive 99 cents on the dollar.

- **Guaranteed renewable**. The insured has the right to continue the insurance policy inforce by the timely payment of premiums and the insurer has no unilateral right to make any change in any provision of the policy or rider while the insurance is inforce except that rates may be revised by the insurer on a class basis, but it cannot decline to renew.

- **Hedgeable risks**. A risk is hedgeable if an active market exists in which it can be traded, such as the case with certain derivatives. Hedgeability derives from the existence of a market and not directly from the characteristics of the risk. In some cases, one risk can offset another one without the benefit of a market if there is a complete negative correlation.

- **Market consistency.** A price that is consistent with either observed or estimated prices in transactions of similar items in a market.

- **Market cost of capital.** There are several well-known methods for establishing the market cost of capital, with the *Capital Asset Pricing Model* (CAPM) arguably being the best known. Other methods include the arbitrage pricing model (of which the market-consistent pricing model is one variant), multi-factor versions of the CAPM of which the Fama-French 3 factor method (FF3M) is perhaps the most well-known, and discounted cash flow (DCF) methods.

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

- **Mitigation**. Risk mitigation is a process or actions taken by an insurer that can be used to manage, control, and reduce adverse cash flows and associated risks and uncertainties.

- **Model risk**. Model risk arises when an incorrect form of model of the future is applied.

- **Moderately adverse**. "Conditions that include one or more unfavorable, but not extreme, events that have a reasonable probability of occurring during the testing period." ASOP 22, *Statements of Opinion Based on Asset Adequacy Analysis by Actuaries for Life or Health Insurers*.

- **Normal distribution.** The normal distribution is a well-known probability distribution that requires two parameters, the mean (or probability-weighted average) that indicates its central point and the standard deviation that indicates its width or uncertainty. It is sometimes described as well-behaved for several reasons, including: (1) it is symmetric in that, for each expected "good news" scenario, there is an identical and equally likely "bad news" scenario and (2) risk measures such as confidence levels and conditional tail expectations depend only on the standard deviation.

  Thus, in this distribution there is a fixed relationship between risk measures based variously on standard deviation, confidence levels or conditional tail expectations. In addition, the central limit theorem demonstrates that the sum of any set of homogeneous and uncorrelated risks will

approximate the normal distribution as the number of risks increases to infinity. Thus, the number of standard deviations to achieve a particular confidence level is constant.

However, the normal distribution is rarely appropriate to be applied in insurance situations, as there are rarely enough risks involved, distributions of individual risks are seldom symmetric, and the risks are usually correlated with factors such as inflation, population morbidity, and court decisions. The total distribution is only "normal" in extremely large portfolios of risks with, at most, partial correlations. As the risk distributions for these policies are not normal, the number of standard deviations from the mean to achieve a particular level of confidence will normally decrease as the risk distribution becomes more skewed.

- **Offsetting**. Offsetting is a mitigation technique that involves a combination of risks, covering risks with a very high negative correlation, if not negative one (-1.0, which behaves exactly in the opposite direction). It takes advantage of the negative correlation between two sets of obligations or rights (items) that can reduce the risk associated with the first set of items.

- **Parameter risk**. Parameter risk arises because information about an underlying probability distribution needs to be estimated and the estimate may be inadequate or incorrect. Also referred to as measurement risk.

- **Pooling**. Pooling of risks takes advantage of the law of large numbers that is particularly relevant when the risks involved are independent of each other. It reduces volatility by reducing random fluctuation around an expected value of a portfolio of similar policies.

- **Process risk**. Process risk is the risk of unavoidable random statistical fluctuations that occur in any stochastic process. Also referred to as statistical risk.

- **Provision for risk and uncertainty (PR&U)**. A component in prices or reserves that reflects the effect of risk and uncertainty. A PR&U has also been referred to as a provision (or margin) for adverse deviation or as an adjustment for risk.

- **Quantile method**. A PR&U method based on confidence levels expresses uncertainty in terms of the extra amount that must be added to the expected value so that the probability that the actual outcome will be less than the amount of the premium or reserve (including the PR&U) equals the target level of confidence over the selected time period. This level is also sometimes called the Value at Risk or VaR.

- **Reserve**. The actuarially calculated liability for insurance policies, in either regulatory or general purpose financial statements. In many cases, concepts discussed in this paper regarding premiums are equally applicable to reserves.

- **Risk**. Deviations from expected. According to Knight, "Situations with risk were those where the outcomes were unknown but governed by probability distributions known at outset … where decision making rules such as maximizing expected utility can be applied."

- **Risk distribution.** A risk distribution (or simply, distribution) gives the probabilities that different possible outcomes of an uncertain process will occur.

- **Risk level.** A risk level is often expressed as a multiple of the standard deviation or numbers of quantiles desired.

- **Skewness.** Most insurance risks have a relatively small probability of having a transaction (an occurrence in an insurance policy, such as a voluntary lapse, death, claim, or claim termination) during an experience period. Statistically, distributions of variables such as these with an adverse (right side) tail of the distribution fatter or more likely than the favorable (left side) tail of the distribution are described as having *positive skewness* or being *skew*. They have a parameter that represents the degree of skewness (represented by γ, the Greek lower case gamma), that is greater than zero. The normal distribution, because it is symmetric, has zero skewness.

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

- **Standard deviation**. A statistical measure of the dispersion of a probability distribution. It is the square root of the sum of the dispersion of the expected or actual dispersion around the expected value.

- **Uncertainty**. Knight indicated "where the outcomes were likewise random, but governed by an unknown probability model". "Existing (economic) research has primarily relied on measures of volatility and dispersion as proxies of uncertainty." Although stock market volatility is the most commonly used proxy for uncertainty, it is not considered relevant to the study of LTCi.[xiv]

- **Volatility**. The tendency for experience to differ from that which is expected from period to period. This is a result of stochastic processes associated with the relationship between policyholders and their insurers, as well as changes in the physical and mental condition of policyholders and their families.

References and Endnotes

M. Allaben et al. (2010). "Principles Underlying Actuarial Science." *Proceedings of the 29th International Congress of Actuaries.* Capetown, South Africa, March 2010.

N. Bloom. (2014). "Fluctuations in Uncertainty." *Journal of Economic Perspectives*. v28(2). Spring 2014. 153-76.

S. Desai (2014). "Incentivizing Desired Behavior in Long-Term Care Policies." *Society of Actuaries' Long-Term Care News*. April 2014. 16-19.

International Actuarial Association (2009). "Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins." 15 April 2009. Ottawa, Canada. http://www.actuaries.org/LIBRARY/Papers/IAA_Measurement_of_Liabilities_2009-public.pdf

K. Jurado, S.C. Ludvigson, S. Ng. (2013). "Measuring Uncertainty." *NBER Working Paper Series – Working Paper 19456*. National Bureau of Economic Research.

F. H. Knight (1921). "Risk, Uncertainty, and Profit". Boston, MA: Hartner, Schaffner & Marx; Houghton Mifflin Company. ISBN 978-0-9840614-2-6.

R.N. Langlois, M.M. Cosgel (1993). "Frank Knight on Risk, Uncertainty, and the Firm: a New Interpretation". *Economic Inquiry*. Vol. XXXI, July 1993, 456-465.

S.F. LeRoy, L.D. Singell, Jr. (1987). "Knight on Risk and Uncertainty." *Journal of Political Economy*. April 1987. 394-406.

R. Loomis, C. Churchill, J.M. Crooks, J. Heim, L. Semchyshyn (2014). "Understanding the Volatility of Experience and Pricing Assumptions in Long-Term Care Insurance." *Society of Actuaries*.

K.R. Popper (1965). "Conjectures and Refutations: the Growth of Scientific Knowledge." Harper Torchbooks.

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[i] In contrast, in some cases these values are derived considering multiple approaches or bases (e.g., by means of Bayesian or actuarial credibility approaches, weighting of different methods based on alternative metrics, and deterministic best-estimate, median or other non-probabilistic approach. Nevertheless, once the estimate is developed, often a probability distribution(s) can be derived to assess probabilities of alternative outcomes or scenarios.

[ii] F. H. Knight. (1921) 19-20

[iii] F.H. Knight. (1921) 211

[iv] D.H. Rumsfeld. (2002). Speech at a U.S. Department of Defense New Briefing, February 2002.

[v] N. Bloom. (2014). "Fluctuations in Uncertainty. *Journal of Economic Perspectives*. v28(2). Spring 2014. 153-76.

[vi] R.A. Buchanan. (1997). Utility estimation. *Proceedings 28 Int. ASTIN Colloquium*. Cairns, Australia. 413-426.

[vii] V. Zinkovsky. (2007). Risk margins to the non-market risks under FAS 157: suggested approach. *Society of Actuaries Financial Reporter*, December 2007.

[viii] U.S. See www.actuarialstandardsboard.org/pdf/asops/asop019_034.pdf

[ix] See http:/www.aib.org/RPP/Myers-Read.pdf

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

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

[xii] M. Allaben et al. (2010)

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

[xiv] K. Jurado, S.C. Ludvigson, S. Ng. (2013). "Measuring Uncertainty." p6 and 13.