Canadian Life and Health Insurance Association Inc.

Reserve Methodology and Solvency Standards For Variable Annuities in Japan

Joint Interim Proposal

June 17, 2004

The American Council of Life Insurers,
The European Business Community, and
The Canadian Life & Health Insurance Association Inc.

I. Background

The rapid growth of Japan's variable annuity market to 3.1 trillion yen in assets as of March 31, 2004, up from only 580 billion yen 18 months earlier, reflects a strong demand for retirement savings products in Japan. With over 557,000 contracts in force as of March 31, 2004, it is clear that variable annuities already serve as an effective retirement planning tool for hundreds of thousands Japanese citizens.

The variable annuity industry in Japan has also become a key success story in the financial services "big bang" liberalization process and has contributed to the revitalization of the financial sector. Growth of the variable annuity industry has contributed to increased capital investment, employment, and individual investor participation in the equity markets, and by providing an important new source of fee income to banks, asset managers, and securities firms.

However, the complexity of principal guarantees offered in variable annuity products, makes it important to use the best methodology available to accurately measure the interest rate and equity risks associated with those guarantees. In response to the rapid development of Japan's variable annuity market in recent years, the American Council of Life Insurers (ACLI), the European Business Community (EBC) Insurance Committee, and the Canadian Life & Health Insurance Association Inc. (CLHIA) have prepared a joint interim[1] proposal for reserve and solvency requirement methodology for variable annuities in Japan.

The joint interim proposal is based on careful study of current trends and lessons learned in the U.S. and Canada and how they can be applied in Japan. Our proposal is based on a stochastic methodology based on realistic (not risk neutral) scenario testing under which all policy cashflows are projected. Reserves and capital are then determined by using a statistical measure (Conditional Tail Expectations) that focuses on the tail of the loss distribution. This methodology has been developed in Canada and the United States, but our proposal uses assumptions and an investment model that have been customized for the Japanese economic environment. This methodology is more complex to implement than formula and factor-based methodologies, but we believe it serves policyholder and regulatory interests better because it is more accurate for calculating appropriate reserve and solvency levels based on changing market risk and product features.

It is important that reserve and capital requirements be set at appropriate levels, neither too low nor too high, and that these reserve levels are adjusted in a dynamic manner during periods of equity market and interest rate volatility. If reserves and capital requirements are set too low, then the long-term financial stability of the industry and policyholder's savings could be at risk. On the other hand, if reserves and capital requirements are set unnecessarily high, then this would lead to inefficient use of capital and the excess costs would be transferred to consumers, either in the form of higher prices or less innovative products or both. In addition, it is important that reserve and capital requirements are based on a consistent methodology for the measurement of risk.

The methodology in our joint interim proposal would ensure appropriate reserve and solvency levels in volatile markets and fosters the use of rational pricing and risk management by insurance companies. The proposal would ensure policyholder protection by more accurately measuring risk in a comprehensive manner and linking reserve and solvency levels to changes in risk in a dynamic manner. The proposal would also keep the industry financially sound and able to provide appropriately priced and innovative products to consumers because it would not require companies to hold unnecessarily high levels of reserves or capital.

[1] Based on feedback we receive on this interim report, the ACLI, CLHIA and EBC plan to revise this joint proposal by the end of July 2004 and re-announce it as our final proposal.

Conservatism in reserves can either be introduced by using a risk adjusted expected cost or by using conditional tail expectation (CTE) statistical measurements. The risk adjusted expected cost approach adds conservatism using assumptions that are intentionally set in a conservative manner when projecting future scenarios, rather than using "best estimate" assumptions. As a result, in formula or factor-based methodologies that use a risk adjusted expected cost approach, the desired level of conservatism is established in a subjective manner by setting assumptions, such as the expected rate of return, at below "best estimate" levels.

Our proposal uses an explicit and transparent means of providing for conservatism in the reserves by using appropriate parameters in the Conditional Tail Expectation (CTE) calculation. The company first calculates the potential liability over a large number of scenarios using "best estimate" assumptions for investments and then reflects conservatism by considering only a certain proportion of the worst scenarios. For example, CTE (60) would ignore the 60% of the "best" scenarios and average the cost over the 40% of the "worst" or most costly scenarios. As a result, it is important to use the most realistic "best estimate" assumptions possible when using CTE statistical measurements, to avoid excess conservatism.

Some key features of the proposed methodology include:

1) To use CTE statistical measurements to set premium reserve levels, maximum contingency reserve levels and minimum solvency margin levels in a consistent manner. To allow companies to set premium reserves for guarantees in the general account freely between CTE(60) and CTE(80) and to allow companies to change the level within this range from reporting period to reporting period. The proposed component for interest rate risk in the denominator of the solvency margin ratio for variable annuities is CTE(90) minus the premium reserve held.
2) To require premium reserves in the special account to consist of 100% of the account value.
3) Allow companies to choose one of the following:
    a. Hold a credit in the general account, in the form of an asset or negative liability, for unamortized acquisition expense to allow for the difference in timing between revenues and expenses. At the same time, the premium reserves in the general account should include the future unamortized expenses as cash flows in developing reserves to ensure sufficient funds are available to amortize the acquisition expenses in the future.
    b. Reflect acquisition expenses as incurred and so hold no credit in the general account for unamortized acquisition expense. In this case the premium reserves in the general account would not include future unamortized expenses as cash flows in developing the premium reserve in the general account.
4) The numerator of the solvency margin formula should include a credit for Reserve less Cash Value where

    Reserve = premium reserve in special account
    \+ premium reserve in the general account
    \- unamortized acquisition expense credit in the general account (if any)

    Cash Value = greater of:
    i the account value less the surrender charge
    ii the total premium reserve (in general account and special account) when applying a full term Zillmer method.
5) To give credit for the excess of the premium reserve for the guarantees in the general account over the minimum level of CTE(60) in the numerator of the solvency margin ratio.
6) To require companies to use assumptions in determining reserves and required capital that

reflect expected future experience, with appropriate allowances for uncertainty. Such assumptions would typically be consistent with emerging company and industry experience.

7) To reflect the total benefits, expense and premiums of the policy in determining reserves rather than restrict the calculation to a limited subset.
8) To explicitly model policyholder behavior, including estimates of lapse and withdrawals.
9) To reflect risk management activities such as hedging and reinsurance in determining both the premium and contingency reserves.

It is important to note that we intend our proposal to be a total package and it would not be appropriate to implement it in a partial manner.

On behalf of the ACLI, EBC and CLHIA, Hartford Life International Inc. engaged Mercer Oliver Wyman Actuarial Consulting Limited to review the methodology and to assist in the development of an economic model for investment returns to serve as an example of the types of models that companies should consider. The model generates 10,000 annual scenarios for each of four asset classes using a stochastic Monte Carlo simulation.

The economic model is intended for real-world projections of the potential cash flows on variable annuity products. It is not designed for the pricing of options and other derivatives. The model integrates interest rates and equity returns on both foreign and Japanese markets through a covariance structure parameterized from historic data. The historic data taken from the last 30 – 40 years are also used to estimate future expected returns within an internally consistent risk-return framework. All parameters are estimated using the method of maximum likelihood with constraints and judgment applied.

Based on the 10,000 scenarios generated, the ACLI, EBC and CLHIA engaged the insurance and actuarial consulting firm Milliman Japan to 1) conduct an in-depth sensitivity testing to facilitate understanding of our proposed methodology and 2) conduct a study of how our proposal compares to other methodologies such as those being considered for implementation in Japan and the U.S. and methodologies being used in Canada. The comparisons are based on the percentage of 10,000 scenarios that would be covered by total reserve and capital requirements and show that our proposed methodology covers sufficient scenarios.

The member companies of the ACLI, EBC and CLHIA hope to cooperate with Japanese regulators and the Japanese industry to develop appropriate reserve methodology and solvency standards to ensure policyholder protection and the financial stability of the industry. We are also confident that our proposed methodology would ensure that variable annuities can continue to serve as a cost-effective and innovative retirement planning tool for people in Japan.

II. Valuation Methodology

The methods described below are examples of methods that the ACLI, EBC, and CLHIA think are reasonable. We do not preclude the use of other methods as long as chief actuary of each company judges them to be reasonable and appropriate in light of the business and financial position of the company.

1. Applicable Products

Variable annuities with a minimum guarantee.

2. Enforcement Timing

Policies issued after the beginning of fiscal 2005 (April 1, 2005).

3. Cash Flow Testing

All variable annuity products with minimum guarantee are included in the cash flow testing regardless of issue year.

4. Premium Reserves for Assets in Special Account

Our proposed valuation method for the premium reserve in the special account is to consist of 100% of the account value.

Rationale: In accordance with Insurance Business Law Enforcement Regulations Article 69, Item 4, section 3, Article 69.

5. Credit for General Account

We propose that companies be allowed to choose one of the following:

a. Hold a credit in the general account, in the form of an asset or negative liability, for unamortized acquisition expense to allow for the difference in timing between revenues and expenses. At the same time, the premium reserves in the general account should include the future unamortized expenses as cash flows in developing reserves to ensure sufficient funds are available to amortize the acquisition expenses in the future.

b. Reflect acquisition expenses as incurred and so hold no credit in the general account for unamortized acquisition expense. In this case the premium reserves in the general account would not include future unamortized expenses as cash flows in developing the premium reserve in the general account.

Rationale: Item 5a represents a sound accounting and reserving policy in our view. It is an important accounting principle to match the timing of revenues to expenses. For example, major one-time expenses that generate income over an extended period of time are often amortized over the useful lifetime. However it would be imprudent to establish an asset for unamortized expenses if there is unlikely to be enough future revenue to cover the amortization of these expenses. To ensure that there are sufficient funds for amortization, the premium reserve for the guarantee also includes the projected expenses including the scheduled amortization of acquisition expenses.

Through the reserving mechanism, the regulator can be assured with same high probability as for benefits, that there will be sufficient funds available for the amortization of acquisition expenses.

Item 5b results in acquisition expenses being incurred immediately with no deferral to later years. However in the solvency margin numerator, a credit is given for the equivalent of the surrender charge and this gives a similar result as in 5a in terms of effect on the solvency margin. There may be some companies that prefer this second more conservative approach.

6. Premium Reserves in General Account to Cover Policy Guarantees

An additional premium reserve to be held in the general account is determined to cover policy guarantees and to ensure recoverability of acquisition expenses. This reserve is determined using a stochastic investment model generating a large number of stochastic scenarios and then averaging the worst scenarios. For each scenario, the following is calculated.

Scenario Result = PV (benefits) + PV (expenses) – PV (Total revenue)

Where

Benefits = the expected cost of the excess of the guaranteed benefits over the account value. The gain or loss on lapse will also be included here.

Expenses = the remaining acquisition expenses that have not been amortized (if any) and the expected maintenance expenses in each year

Total Revenue = the total policy fees expected under each investment scenario

The premium reserve would be allowed to vary anywhere within a range between CTE(60) and CTE(80) are then calculated as follows:

Minimum Premium Reserve	=	Max[CTE(60),0]
	=	Greater of zero or average of the 40% of the worst scenario results
Maximum Premium Reserve	=	Max[CTE(80),0]
	=	Greater of zero or average of the 20% of the worst scenario results

Rationale: Allowing premium reserve to vary in a range between CTE(60) and CTE(80) is consistent with widely accepted standards of the amount of margin (conservatism) that should be held in reserves and is an objective and transparent level of conservatism, not arbitrary. The CTE statistical measurement measures real risk effectively because it focuses on reserving for the average of the worst scenarios in the tail where the real risk lies, rather than the average of all scenarios.

We propose using all cash flows in determining reserves. This comprehensive approach more accurately reflects the actual financial condition of the company. Applying an approach that considers only pure premium income when calculating reserves can make reserves unnecessarily and arbitrarily conservative.

7. Contingency Reserves

The maximum contingency reserve would be funded as a Contingency Reserve II in the general account and calculated as CTE(90) less the Premium Reserves. Funding of the contingency reserve is at a minimum an accumulation of the pure premium assumed for the guarantee. Where the accumulation of pure premiums exceeds the maximum (for example, CTE(90) is lower than before), it is expected the company will maintain the prior contingency reserve, neither increasing it for further accumulated risk premiums nor reducing it to the new maximum level except as specified in the next paragraph.

Contingency reserves can be reduced by the amount not exceeding the sum of below.

(a) Minimum guaranteed benefits paid.
(b) The increase of premium reserve for minimum guarantee in general account from the previous fiscal year end.
(c) In case that the minimum guarantee risk is reduced due to hedging or reinsurance, the amount of hedging or reinsurance expense which a chief actuary judges to be reasonable as the expense of the current term.
(d) Amount that a chief actuary judges to be reasonable and allocates to policyholders or shareholders as a dividend based on surplus on minimum guarantee.

The maximum limit of withdrawal is the amount of contingency reserve as of previous fiscal year end and increase in current fiscal year is not included in this amount.

Rationale: Holding a contingency reserve is consistent with current Japanese law and industry practices. It is desirable to link maximum contingency reserve levels to the risks inherent in each product.

8. Surplus Capital Requirements (Solvency Margin Ratio)

The proposed component for interest rate risk in the denominator of the solvency margin ratio for variable annuities is CTE(90) minus the premium reserve held.

The numerator in the solvency margin formula is to include credits for the following.

1. Reserve less cash value.
2. The amount in the premium reserves held in the general account that exceeds the CTE(60) minimum value.
3. Contingency reserves.

The reserve in item one above consists of the following.

Reserve = premium reserve in special account
\+ premium reserve in the general account
\- unamortized acquisition expense credit in the general account

Cash Value = greater of:
a. the account value less the surrender charge
b. the total premium reserve (in general account and special account) when applying a full term Zillmer method.

Rationale: This is consistent with evolving practice and standards in other countries and is well aligned with the real world modeling where we need to focus on the worst scenarios in the tail results. It would result in capital levels that could cover over 90% of all scenarios when the solvency margin ratio is equal to 200%, and cover an even higher percentage of scenarios when the solvency margin ratio is at the 600% to 1,000% levels that are more common in practice. The amount of the premium reserve exceeding the minimum level of CTE(60) reflects additional margin in the reserve and is similar to surplus, so it should be counted as a credit in the numerator in the solvency margin ratio formula, similar to the contingency reserve.

9. Survivor Risk for Whole Life Annuity Payouts

The 1% of account value for survivor risk is not required to be funded until the policyholder or beneficiary has actually begun receiving their annuity payments.

Rationale: The survivor risk for whole life annuity payout options is not incurred until after the annuity payout option has been implemented. Under current rules, the minimum deferral period before an annuity option may be exercised is 10 years. It is unduly conservative to require funding for this reserve many years before the annuity payout option may be elected.

10. Credit for Effective Risk Management

Reserves and surplus capital requirements should be reduced in proportion to the amount of risk reduction due to such actions as reinsurance and capital markets hedging.

Rationale: This approach reflects the underlying economics and is consistent with the principle of neither holding too much reserve nor too little.

11. Discount Rate

A discount rate of 1.5% is used to take the present value of cash flows in calculating the reserves.

Rationale: This is the current standard in Japan.

12. Mortality

Mortality is assumed to follow 100% of the 1996 annuity table.

Rationale: Reflects expected mortality for the insured.

13. Lapse

The chief actuary should choose lapse assumptions that is at the conservative side of reasonable expectations and that reflect the underlying economics as accurately as possible.

Rationale. There are too many different products and guarantee types for a single set of assumptions to be used.

Below is a sample set of dynamic lapse assumptions that assume lapse experience varies with fund performance and with the nature of the guarantee offered. We believe this sample to be sufficient for the purpose of performing calculations that illustrate the percentage of scenarios that would be covered by reserve and capital levels using the ACLI-EBC-CLHIA interim proposal. However, this sample is meant to be purely illustrative and is not intended as the only option available. There may be alternative lapse assumptions that may be as or more appropriate.

The base lapse assumption starts with a lapse rate of 2%. The lapse rate is assumed to increase as the surrender charge declines over time. There is also assumed to be a large spike in lapses in the first year after the surrender charge no longer applies. When the surrender charge no longer applies there may be several motivations to lapse the product.

- The policyholder needs the funds but does not want to pay the surrender charge.
- Guarantees may be out of the money so a new policy will allow these guarantees to be "reset" at a higher level
- New products with new features or better pricing may be available.
- The distribution system, particularly third party distributors, are motivated by high up front commissions to sell the policyholder a new policy

Base Lapse Assumption

Policy Year	Japan Lapse Rate
1	2.0%
2	2.0%
3	2.0%
4	2.5%
5	3.0%
6	4.0%
7	5.0%
8	20.0%
9+	8.0%

Lapse experience is assumed to vary with the value of the guarantee. The lapse rates from the table above are multiplied by the following factors depending on the guarantees present in the product. The following multipliers are used when the guarantee is in the money.

In the money Multipliers:

Multiplier = Max [50%, 1-1.5 * (ITM% - 10%)] when ITM% > 10%

= 100% otherwise

where ITM% = GMB/AV – 1

In words, the multipliers have no impact on lapse rates if the benefit is in the money by 10% of the account value or less. To the extent the policy is in the money by more than 10%, this excess goes to reduce the expected lapse rates. The maximum effect of each multiplier is limited to 50%.

Similar multipliers are applied when a guarantee is out of the money and serve to increase the base lapse rates when the guarantee is more than 10% out of the money.

Out of the money Multipliers:

Multiplier = Min [150%, 1-1.5 * (ITM% + 10%)] when ITM% < -10%

= 100% otherwise

14. Aggregation of Policies

In principle, aggregation should be done across all policies with no limits.

Rationale: Insurers can manage risk by offering different product designs and guarantees. To some extent one product feature may offset the risk of another product feature. To accurately reflect the total risk to the total portfolio, aggregation must be done across all policies with no limits. To put artificial constraints may add arbitrary and unnecessary levels of conservatism to reserves.

Unit of calculation: Present value of income and expense may be calculated by policy or by groups, but grouping should be implemented in a way that generates the same results as a seriatim valuation, within materiality considerations (e.g. in case of same product, age, sex, account value status and fund allocation).

Unit of zero floor: Present value of expense minus income can be calculated across all policies or zero floored after reasonable aggregation. When aggregation completed, if the present value of benefits and expense minus income is positive, premium reserve for the guarantee is increased by that amount. If the present value of income exceeds the present value of benefits and expense, the premium reserve is not allowed to become negative.

15. Investment Model

Under a stochastic methodology based on realistic (not risk neutral) scenario testing under which all policy cashflows are projected and where a CTE statistical measure is used to determine reserves and capital, the historic data period for parameter estimation should be long enough to capture both good and bad economic cycles and hence should permit a reasonable model for plausible future scenarios, particularly those adverse scenarios which are captured in the CTE measure. In general the investment model is developed using historic data covering a period at least twice as long as the longest benefit period. The historic period should cover both good and bad periods so as not to be unduly conservative or unduly optimistic.

Good investment models may be difficult and complicated to develop. It is inappropriate to specify a specific investment model for use in calculating reserves as new and better models will continue to be developed. Rather, companies should be free to use alternative investment models that the Chief Actuary feels are more appropriate for the risks assumed for that particular company.

III. Sample Investment Model

On behalf of the ACLI, EBC and CLHIA, Hartford Life International engaged Mercer Oliver Wyman Actuarial Consulting Limited to review the methodology and to assist in the development of an economic model for investment returns to serve as an example of the types of models that companies should consider. The following sample investment model was created by first developing and testing both lognormal and regime switching models and then fitting those models to historical data.

We believe this sample investment model to be sufficient for the purpose of performing calculations that illustrate the percentage of scenarios that would be covered by reserve and capital levels using the ACLI-EBC-CLHIA interim proposal. However, any figures produced based on this model are meant to be purely illustrative. This investment model is not intended as the only option available, but rather is an example of an initial attempt to develop a model that fits the criteria in our proposal. There may be alternative models or calibrations that may be as or more appropriate.

Also, based on any feedback we may receive, the ACLI, EBC, and CLHIA plan to revise and improve this sample investment model before we issue the final version of our joint proposal at the end of July.

Selection of Models

Although the regime-switching lognormal model[2] with two regimes ("RSLN2") offers some significant advantages over simpler models (e.g., negative skewness, positive kurtosis, "volatility clustering") for simulating equity returns, it is generally not well suited to modeling the market returns on fixed income funds (or the fixed income component of balanced asset allocations). This is predominantly due to the artificial nature of the regimes and the underlying assumption that the switching model and returns are pure Markov processes without any form of mean reversion.

For the analytical work underlying the proposal, the ideal model would simulate at least 7 correlated stochastic processes, as follows:

1. RSLN2 model for Japanese Equity, parameterized from the "TOPIX" index in local currency;
2. RSLN2 model for Foreign Equity, parameterized from the "MSCI Kokusai - ex Japan (Net)" index in local currency;
3. Japanese 10-year bond yield;
4. Foreign 10-year bond yield (e.g., U.S. 10-year Treasury);
5. Japanese bond fund returns (function of Japanese 10-year yield);
6. Foreign bond fund returns (function of Foreign 10-year yield); and
7. Currency exchange rates (function of interest rates).

The last process (a currency exchange rate model) may be unnecessary if we assume that current exchange rates persist forever. This seemingly invalid assumption can be quite reasonable if we are convinced that one (or both) of the following statements are true:

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2 See "A Regime-Switching Model of Long-Term Stock Returns", M.R. Hardy, *North American Actuarial Journal*, Volume 5, Number 2 (April 2001).

- Over the long term (starting from May 2004), the Yen will neither appreciate nor depreciate systematically relative to foreign currencies (notably, the U.S. dollar).
- Any fluctuation or trend in currency exchange rates is overwhelmed by the "local currency" (i.e., nominal) volatility in asset returns.

For purposes of this interim report we subscribe to this last viewpoint and consider all historic data in local currency. Furthermore, we adopted the following approach as both theoretically sound and practical to implement in the timeframe available for analysis.

- Both equity markets (Japan and Foreign equity) are modeled according to an RSLN2 process.
- The random components are distributed according to a multi-variate normal distribution with constant correlation matrix (i.e., the correlations do not vary by regime).
- The process which controls the switching of regimes is subject to interpretation. There are several alternatives which can be used in practice (e.g., all markets switch regimes at the same time, switching is independent, etc.). We assume that regime transitions are highly, but not perfectly, correlated. Under this technique, the markets can be in different regimes in any given month, but there is a strong tendency for them to "revert" to the regime occupied by the lead or dominant market.
- In simulating RSLN2 returns, we randomize the starting regime according to the invariant probabilities.
- Interest rates are modeled according to a discrete-time Cox-Ingersoll-Ross process.
- Returns on fixed income funds are modeled as a function of interest rate movements.

Market Data

Real world[3] scenarios were generated for the asset classes shown in Table 1. Parameters are determined by fitting the models to data over the specified historic period using the method of maximum likelihood, with some modest subjective adjustments to conform to a loose interpretation of market efficiency.

Table 1: Asset Classes for Scenario Modeling

Asset Class	Market Proxies	Historic Period	Notes	Scenario File
Japan LT Interest Rates	Japan 10-yr Government Bond Yields	1966.01 – 2004.02	(1)	JGB_10y.csv

[3] These scenarios are generated according to the realistic (i.e., "true") probability measure (sometimes called the physical, or *P*-measure) whereby investors expect to be compensated for bearing additional risk. These models are characterized by a subjective relationship between "risk" and "reward", typically derived through a combination of historic data analysis and professional judgment regarding potential future experience. Despite their subjective elements, such models permit an informed analysis of the plausible range of outcomes, including those adverse scenarios which require the greatest outlay by the insurer. In contrast, the risk neutral probability measure (denoted *Q*-measure) is predicated on the theory of replication and the no-arbitrage pricing principle. In a risk neutral world, investors diversify and hedge their exposures, thereby guaranteeing a known set of outcomes in all future environments. As such, investors do not require compensation for assuming risk, and all assets (risky and otherwise) are expected to earn the risk free rate. While the *Q*-measure is crucial to option pricing, it is important to remember that it tells us nothing about the true probability distribution. The *Q*-measure is relevant only to pricing and replication; any attempt to project values ('true outcomes') for a risky portfolio must be based on an appropriate (and necessarily subjective) *P*-measure.

U.S. LT Interest Rates	U.S. 10-year Treasury Yields	1966.01 – 2004.02	(1)	UST_10y.csv
Japan Equity	TOPIX Total Return Index	1964.12 – 2004.02	(3)	TOPIX.csv
Japan Fixed Income	Nomura BPI	1983.12 – 2004.02	(2)	NOMURA.csv
Foreign Equity	MSCI Kokusai ex Japan $LOCAL	1969.12 – 2004.02	(3)	KOKUSAI.csv
Foreign Government Bond	U.S. Intermediate Government $US	1966.01 – 2002.12	(2)	USITGVT.csv
Foreign Corporate Bond	U.S. Long-Term Corporate Bonds $US	1966.01 – 2002.12	(2)	USLTCORP.csv
Foreign Fixed Income	65% USITGVT + 35% USLTCORP	1966.01 – 2002.12	–	USBOND.csv

Model Descriptions and Notes

- Pseudo-random numbers are generated using the Mersenne Twister algorithm[4]. Variance reduction techniques were not used.

- Equity returns are generated from a monthly regime-switching lognormal model with two regimes (“RSLN2”). In any given month the markets may be in different regimes, but once misaligned there is a strong tendency for the regimes to become synchronized again. The starting regime is randomized according to the *average* invariant probabilities (i.e., 57.24% of the scenarios start in regime 1).

- The correlation between asset classes does not vary by equity market regime.

- Within sampling error, the RSLN2 Japan Equity model (TOPIX) satisfies the proposed calibration criteria (see later under “Calibration Criteria”).

- Additional scenarios can be created (e.g., Balanced Asset Allocation) by blending the accumulation factors for the market proxies.

(1) Interest rates on domestic (Japanese) and foreign government debt are simulated by a real-world[5] discrete-time Cox-Ingersoll-Ross (“CIR”) stochastic process:

$$\tilde{i}_t = \left[(1-\tilde{a})\cdot\tilde{i}_{t-1} + \tilde{a}\cdot\tilde{t}\right] + \tilde{s}\cdot\sqrt{\tilde{i}_{t-1}}\cdot\tilde{Z}_t$$

$$i_t = \left[(1-a)\cdot i_{t-1} + a\cdot t\right] + s\cdot\sqrt{i_{t-1}}\cdot Z_t$$

[4] The Mersenne Twister is a well-documented and robust algorithm with extremely high periodicity.

[5] The interest rate model is designed for cash flow projections only. It is not arbitrage-free and could give inappropriate values if used to price individual securities or derivatives as part of an asset/liability management strategy.

The processes $\tilde{i}_t$ and i_t respectively represent the yields on long-term (10-year) Japanese Government Bonds ("JGB") and U.S. Treasuries. $\tilde{Z}_t$ and Z_t are correlated normal variates with zero mean and unit variance. The parameters $(\tilde{a}, a)$ are the mean-reversion strengths and $(\tilde{t}, t)$ are the long-term target rates.

The CIR process is simple, but has some attractive properties (e.g., the probability of negative interest rates is extremely small, mean-reversion, volatility varies with the level of interest rates, etc.) and is able to represent a broad array of interest rate movements. The monthly parameters for the two processes are shown in Table 2. The correlation co-efficient between the processes is $r = 0.1245$. The starting values closely correspond to the rates at the end of February 2004.

Table 2: Model Parameters for Cox-Ingersoll-Ross Interest Rate Processes

	a	t	s	Starting Rate
10-year JGB Yields	0.00595	3.346%	0.01158	1.24%
10-year UST Yields	0.00764	7.245%	0.01080	4.08%

(2) Fixed income (e.g., bond) returns are generated according to the process:

$$r_t = b_0 \cdot (i_t + k) - b_1 \cdot (i_t - i_{t-1}) + s \cdot (i_{t-1})^g \cdot Z$$

where Z is a standard normal variate. The model parameters are shown in Table 3.

Table 3: Model Parameters for Fixed Income (Bond Fund) Returns

	b_0	k	b_1	s	g
NOMURA	0.08333	0.00274	3.88760	0.14737	1.0
USITGVT	0.08333	0.00027	3.62348	0.03984	0.5
USLTCORP	0.08333	0.00584	5.58475	0.06530	0.5

(3) Equity market parameters are determined by MLE techniques, subject to the following constraints:

- Unconditional volatility (standard deviation of monthly log returns) = historic volatility;
- Sharpe ratio = 0.2923.

The Sharpe Ratio y is defined by:

$$y = \left(\frac{E[R_k] - r}{s_k} \right) = 0.2923$$

defined by the historic TOPIX Total Return Index over the period 196412 to 2004.02 inclusive. For the k^{th} market s_k is the unconditional annualized standard deviation (volatility) of monthly log returns and $E[R_k]$ is the unconditional mean, expressed as an annual effective rate. In this calculation, we assume that the risk-free rate r = 3.345% (effective), the target long-term 10-year Japanese Government Bond yield based on the CIR parameterization to the historic data.

Regime Switching Lognormal Model

The equity return scenarios are generated from a monthly regime-switching lognormal model with two regimes ("RSLN2"). The RSLN2 parameters for Japanese Equity are the maximum likelihood estimates based on monthly TOPIX total return data from December 1964 to February 2004 inclusive. The starting regime has been randomized according to the "average" invariant probability $p = 0.5724 = 0.5 \times (0.3241 + 0.8206)$.

Table 4 shows the RSLN2 parameters and Table 5 gives the values of the log-likelihood function and Schwartz-Bayes Criterion[6] for each parameter set. The mean (μ) and standard deviation (σ) are for the associated normal distribution in each regime (i.e., the log total return in each regime is normally distributed). ρ12 and ρ21 are the conditional regime-switching probabilities.

The differences between the maximum likelihood ("MLE") and model parameters for "Foreign Equity" (MSIC Kokusai ex Japan in Local Currency) are due to the aforementioned Sharpe Ratio constraints. The differences are not statistically significant. For both equity markets, the RSLN2 model provides a statistically better fit[7] to the historic data than the simpler lognormal model with constant mean and variance.

Table 4: RSLN2 Parameters (Monthly) – Equity Markets

	μ1	σ1	ρ12	μ2	σ2	ρ21	π1	π2
TOPIX	0.00995	0.02687	0.04477	0.00324	0.05846	0.02147	0.32414	0.67586
KOKUSAI – MLE	0.01385	0.03199	0.04539	-0.02440	0.06836	0.23086	0.83571	0.16429
KOKUSAI	0.01190	0.03168	0.05062	-0.02779	0.06523	0.23148	0.82056	0.17944

Table 5: Values for the Log Likelihood Function and Schwartz-Bayes Criterion

	Regime-Switching Lognormal		Lognormal	
	Log Likelihood	SBC	Log Likelihood	SBC
TOPIX	763.954	745.495	736.771	730.618
KOKUSAI – MLE	744.309	726.260	712.208	706.192
KOKUSAI	743.317	725.269		

Correlations

[6] The Schwartz-Bayes Criterion ("SBC") attempts to reflect both "goodness of fit" and the parsimony of the model for the given number of data points. Including more variables in a model will never decrease the log-likelihood function, but that alone does not suggest that a highly parameterized model is preferable. All else being equal, we prefer simpler (i.e., fewer parameters) models to complex formulations.

[7] In each case, the SBC is higher for the RSLN2 model.

A single correlation matrix is used for the integrated (equity returns and interest rates) scenario model – see Table 6 (i.e., correlations do not vary by the equity market regime). The matrix is decomposed using the standard technique of Cholesky factorization in order to generate correlated normal samples.

Table 6: Correlation Matrix for Integrated Scenario Model

	TOPIX	KOKUSAI	JGB_10	UST_10	NOMURA	USITGVT	USLTCORP
TOPIX	**1**	0.476	-0.058	-0.048	0.064	-0.064	-0.004
KOKUSAI	0.476	**1**	-0.119	-0.218	-0.069	-0.011	0.254
JGB_10	-0.058	-0.119	**1**	0.125	0.046	0.036	0.017
UST_10	-0.048	-0.218	0.125	**1**	-0.227	0.018	-0.006
NOMURA	0.064	-0.069	0.046	-0.227	**1**	0.354	0.409
USITGVT	-0.064	-0.011	0.036	0.018	0.354	**1**	0.648
USLTCORP	-0.004	0.254	0.017	-0.006	0.409	0.648	**1**

Table 7A shows the historic correlations based on monthly log return data for the observation periods used in the parameter estimation. Sample correlations for the 10,000 monthly return scenarios are given in Table 7B. The differences between the observed (historic) and sample correlations are not statistically significant.

Table 7A: Historic Correlations Based on Monthly Log Returns

	TOPIX	KOKUSAI	NOMURA	USITGVT	USLTCORP
TOPIX	**1**	0.422	0.095	-0.001	0.031
KOKUSAI	0.422	**1**	0.049	0.123	0.286
NOMURA	0.095	0.049	**1**	0.305	0.325
USITGVT	-0.001	0.123	0.305	**1**	0.827
USLTCORP	0.031	0.286	0.325	0.827	**1**

Table 7B: Sample Scenario Correlations for the Monthly Log Returns

	TOPIX	KOKUSAI	NOMURA	USITGVT	USLTCORP
TOPIX	**1**	0.420	0.074	-0.011	0.028
KOKUSAI	0.420	**1**	0.060	0.126	0.289
NOMURA	0.074	0.060	**1**	0.245	0.269
USITGVT	-0.011	0.126	0.245	**1**	0.817
USLTCORP	0.028	0.289	0.269	0.817	**1**

Sample Statistics

Sample investment return statistics for the 10,000 scenarios are given in Table 8. "Drift", "Volatility" and "Skew" are respectively the annualized unconditional mean, annualized unconditional standard deviation and skewness of the monthly log returns. "Mean" is the average 20-year total return on the asset expressed as an annual effective rate. "Stdev1" is the unconditional standard deviation of the 1-year accumulation factor.

Note that the underlying log monthly returns are not normally distributed (see earlier under "Model Descriptions"). As such, it is not correct to interpret the drift and volatility as the parameters for a normal (or lognormal) distribution.

Table 8: Sample Investment Return Statistics

	Drift	Volatility	Skew	Mean	Stdev1
Japan Bond	2.58%	2.93%	0.36	2.35%	0.0225
Foreign Government Bond	5.72%	4.80%	0.12	5.52%	0.0442
Foreign Corporate Bond	5.89%	7.69%	0.04	5.75%	0.0700
Foreign Equity	5.62%	14.81%	–0.81	7.55%	0.1796
Japan Equity	6.61%	17.40%	–0.09	8.64%	0.1871

Tail Results and Calibration Criteria

Sample left and right-tail percentiles (2.5%, 5%, 10%, 90%, 95% and 97.5% confidence levels) for the accumulation factors (gross wealth ratios, before deduction of fees) over 1, 5 and 10-year holding periods are shown in Table 9. The calibration criteria for Japanese Equity are computed analytically based on the RSLN2 MLE parameters for the TOPIX dataset (1964.12 – 2004.02 inclusive). Within sampling error, the statistics for the 10,000 scenarios match these values. The calibration points developed by the Canadian Institute of Actuaries' Task Force on Segregated Fund Investment Guarantees[8] (Canadian Equity – RSLN2 fit to the TSX Total Return Index 1956.01 – 1999.12) and the American Academy of Actuaries' Life Capital Adequacy Subcommittee[9] (U.S. Equity – RSLN2 fit to the S&P500 Total Return Index 1952.12 – 2002.12) are shown for reference.

[8] See "*Report of the CIA Task Force on Segregated Fund Investment Guarantees*", March 2002.

[9] See "*Recommended Approach for Setting Regulatory Risk-Based Capital Requirements for Variable Products with Guarantees (Excluding Index Guarantees)*" presented by the American Academy of Actuaries' Life Capital Adequacy Subcommittee to the National Association of Insurance Commissioners' Life Risk-Based Capital Working Group (September 2003 – Chicago, IL).

Table 9: Sample Percentiles for Accumulation Factors

	2.5%	5%	10%	90%	95%	97.5%
Calibration Points: Japan Equity (RSLN2 Fit to TOPIX TR 1964.12 – 2004.02)						
One Year	0.73	0.78	0.85			
Five Year	0.59	0.69	0.81			
Ten Year	0.59	0.72	0.90			
Calibration Points: CIA Task – Canadian Equity (RSLN2 Fit to TSX TR 1956.01 – 1999.12)						
One Year	0.76	0.82	0.90			
Five Year	0.75	0.85	1.05			
Ten Year	0.85	1.05	1.35			
Calibration Points: AAA LCAS – U.S. Equity (RSLN2 Fit to S&P500 TR 1952.12 – 2002.12)						
One Year	0.76	0.83	0.90	1.34	1.41	1.47
Five Year	0.75	0.87	1.03	2.67	3.01	3.31
Ten Year	0.93	1.13	1.41	5.55	6.57	7.55
Japan Bond						
One Year	0.97	0.98	0.99	1.07	1.09	1.11
Five Year	1.02	1.03	1.04	1.28	1.35	1.42
Ten Year	1.10	1.11	1.13	1.57	1.71	1.87
Foreign Government Bond						
One Year	0.97	0.98	1.00	1.13	1.16	1.18
Five Year	1.07	1.10	1.14	1.60	1.71	1.82
Ten Year	1.27	1.32	1.39	2.39	2.68	2.97
Foreign Corporate Bond						
One Year	0.92	0.94	0.96	1.17	1.21	1.25
Five Year	0.97	1.02	1.08	1.71	1.86	2.02
Ten Year	1.15	1.22	1.31	2.59	2.96	3.35
Foreign Equity						
One Year	0.68	0.75	0.83	1.29	1.35	1.40
Five Year	0.52	0.63	0.76	2.20	2.47	2.73
Ten Year	0.49	0.62	0.80	3.66	4.40	5.17
Japan Equity						
One Year	0.73	0.78	0.85	1.32	1.41	1.50
Five Year	0.60	0.69	0.82	2.29	2.61	2.94
Ten Year	0.60	0.73	0.92	3.99	4.80	5.72

Next Steps: Currency Exchange Fluctuations

It should be noted that the ACLI, EBC, and CLHIA plan to revise this sample investment model before issuing the final version of our joint proposal, based on any feedback received. In particular, we believe the sample investment model could be revised to account for the potential impact of currency exchange fluctuations in at least two ways. One approach would be to refit the RSLN2 parameters in a way that incorporates the potential impact of currency exchange rate fluctuations. A second approach would be to 1) estimate parameters in local currency, 2) define the Sharpe ratio based on an array of global equity markets (rather than based on a single market), and 3) overlay a model for currency exchange rates.

Based on the first approach, Mercer Oliver Wyman Actuarial Consulting Limited conducted some initial analysis of the potential impact of currency for the MSCI Kokusai ex Japan index based on RSLN2 MLE parameters for the period from January 1971 to February 2004 (where E[R] = unexpected return (annual effective), V = unconditional volatility (annualized), s = skewness of monthly log returns).

$LOCAL MLE:	E[R] = 11.55%,	V = 14.70%,	s = -0.82
$US MLE:	E[R] = 11.64%,	V = 14.80%,	s = -0.73
YEN MLE:	E[R] = 8.13%,	V = 17.56%,	s = -0.66

The following '$LOCAL MODEL' is the actual values that we use in our current model (1969.12-2004.02 data) with the Sharp ratio adjustment on the expected return:

$LOCAL MODEL:	E[R] = 7.67%,	V = 14.77%,	s = -0.81

This initial analysis shows there is additional volatility due to floating exchange rates that our current sample investment model does not completely account for (i.e., 17.6% volatility vs. 14.8%). As a result, we could improve our sample investment model if we refit the RSLN2 parameters to yen using the higher volatility value. However, it is also clear that the vast majority of the expected improvements would show up as a higher likelihood of short-term (1-year holding period or less) declines and it is not likely that there would be a significant change in the long-term results that are important for the guarantees common in variable annuities. There are two reasons:

First, if we used our Sharpe ratio to refit the RSLN2 parameters to YEN with the higher volatility of 17.56%, then we would also have to use a higher expected return of 8.48%. Our current model uses lower expected returns (i.e., 8.13% expected returns vs. 7.67% expected returns), and therefore our model already accounts for a significant portion of the additional volatility due to floating exchange rates. Second, it is important to note that the yen data have less skewness (fewer really negative returns relative to the mean) and that model spends 86% of the time in regime 1 (versus 82% in the current model).

However, it is still not clear whether the second approach of creating an explicit currency exchange rate model would result in significantly different results. To answer this question, the ACLI, EBC, and CLHIA plan to revise the sample investment model based on the second approach before issuing the final version of our joint proposal.

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About the American Council of Life Insurers (ACLI)
The American Council of Life Insurers (ACLI) is the largest insurance association in the United States of America with 390 life insurance companies as members and a staff of almost 200. ACLI's members are the leading providers of financial and retirement security products covering individuals and business markets and account for the overwhelming majority of the life insurance premiums and annuity considerations in the United States. The ACLI represents legal reserve life insurance companies and fraternal benefit companies operating in the United States before federal and state policymakers, insurance departments, and the courts. Additional information is available at www.acli.org.

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The European Business Community (EBC) is the trade policy arm of the 13 European National Chambers of Commerce and business associations in Japan. First established in 1972, the EBC works to improve the trade and investment environment for European companies in Japan. The EBC currently represents more than 3,000 local European companies and individuals who are members of their national chambers of commerce. Around 360 of the companies participate directly in the EBC's 27 industry committees and subcommittees, including the Insurance Committee, whose work aims to improve the local business environment in a wide variety of industry sectors. Additional information is available at www.ebc-jp.com.

About the Canadian Life & Health Insurance Association Inc. (CLHIA)
The Canadian Life & Health Insurance Association Inc. (CLHIA), established in 1894, represents 72 life and health insurance companies, which together account for about 97 per cent of the life and health insurance in force in Canada, and administer about two-thirds of the pension plans in the country. Canadian life and health insurers receive over 55 per cent of their worldwide premiums from outside Canada. Additional information is available at www.clhia.ca.