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Managing the Impact of Long-Term Care Needs and
Expense on Retirement Security Monograph

An Affordable Long-Term Care Solution through Risk Sharing

By Kailan Shang, Hua Su, and Yu Lin

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An Affordable Long-Term Care Solution through Risk Sharing

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EXECUTIVE SUMMARY

Long-term care (LTC) protection plays an essential role in maintaining the financial security and the quality of life for retirees. However, the economic conditions and the rising expenses of LTC put a lot of pressure on the social health care system, the insurers, and the retirees. The social health care systems are facing funding stress and will unlikely be able to provide more LTC benefits in the near future. Due to the low and stagnant interest rate environment in the long term and unexpectedly high LTC benefit payments, insurers either increased the premium for LTC protection or exited the market. Many people cannot afford the rising LTC premium when they are also struggling to save for retirement.

It is critical to have an LTC solution that insurers are willing to sell and for which the premium is affordable for middle-class families. There have been innovative ways of providing LTC benefits in recent years. Some combine the LTC benefit with other insurance benefits such as death benefits or annuity payments. The aggregate risk is lower than that of the stand-alone LTC product because the combo product contains offsetting risks. However, it does not necessarily reduce the risk inherent in the LTC protection. Other products add flexibility in the premium and benefit payment to reduce the risk for carriers, but it may not be transparent enough. Moreover, policyholders may prefer different and riskier investment strategies than what insurance companies normally choose.

In this paper, we propose an LTC product that has an investment-risk-sharing mechanism between the insurer and the insured. The investment risk will be partially transferred to the clients with a guarantee that is much cheaper than those provided by traditional LTC products. The insurance risks are still borne by insurers. The benefit is adjustable with a floor, and the premium is flexible. Policyholders can choose their own investment strategies according to their risk tolerance depending on ages, levels of wealth, and other factors. The benefit of the risk-sharing arrangement is three-fold: (a) the risk of the new product is lower for the insurers, (b) the price of the product is flexible and affordable, and (c) more risky investment strategies can be used at the discretion of the policyholders to address the rising LTC expenses.

The paper compares the new design with a traditional LTC product to illustrate different levels of risk for the insured and the insurer. Policyholder behaviors, investment strategies, and risk management are also touched on. It is hoped that the new design leads to an acceptable level of risk for the insurers and an acceptable price for the clients.

1. INTRODUCTION

Over the past few years, the long-term care (LTC) business experienced significant financial difficulties. Tucker (2013) summarized that the reasons are the rising medical costs, the historical low interest rates, and the lower-than-anticipated lapse rates. Many LTC carriers exited the market, and those who stayed raised the rates significantly.

Due to the long duration of LTC coverage and the uncertainty of the timing and amount of benefit payments, it is a great challenge to match the assets and liabilities. The lower-than-anticipated returns with traditional investment strategies result in insufficient funds to provide future benefits. Practitioners have been thinking about using non-traditional investment strategies to manage the investment risk. Stoltzfus and Feng (2011) proposed the use of some alternative investment classes such as convertible bonds, interest rate swaps, and collateralized loan obligations. In addition, liability risks can be transferred through securitization, offshore reinsurance and product redesign.

Many other efforts have been made to reduce the level of risk embedded in LTC products. Chow (2012) quantified the hedge characteristics of the combo products that link LTC with life insurance or annuities. By offering LTC as a rider, the policyholders can accelerate the payment of death benefits or the cash value of the annuity early when needed. This can address policyholders' concerns that they will never receive any benefits from the LTC insurance. The cross-funding feature of the combo products dilutes the sensitivities to key pricing assumptions, and thus reduces the cost. In addition, with favorable tax rules and less restriction on underwriting, these combo products are growing in popularity.

Another approach to address the LTC issues is to share the risk with policyholders. Mohoric (2013) suggested two design changes to the LTC product. Instead of using a fixed inflation adjustment, it is suggested to link it to the consumer price index (CPI) or medical care CPI. The premium adjustment due to inflation can also be linked to the chosen index. By doing this, LTC carriers do not need to guarantee a high level of benefit adjustment. In addition, the LTC premium is suggested to have a yearly increasing structure based on the attained age instead of a level premium based on the issue age. To overcome consumers' concern over the premium increase, partial premium guarantees can be offered such as limiting the amount of annual increase and setting a maximum age at which premiums could increase. Some companies link the LTC benefit with the actual investment performance. John Hancock Benefit Builder allows the LTC benefit to grow with investment earnings. The potential increasing

benefit makes it appealing to the younger generation, as they may not need the care for many years.

Those innovations in the LTC market help reduce the risk exposure of insurers and make the product affordable to the clients. However, the combination product does not reduce the risk inherent in the LTC coverage. Instead of evaluating the stand-alone LTC coverage separately, it can be analyzed together with other insurance coverages. The aggregate risk level is reduced by diversification. From the company's perspective, it does not matter whether the diversification happens within a product line or between two product lines.

Even though some risks are shared with policyholders, there are still rich guarantees provided in the LTC product. Most carriers continue using conservative investment strategies. Policyholders may have a much higher level of risk tolerance than implied from the investment strategies chosen by insurers. Therefore, there is a need to increase the level of investment risk sharing and allow more flexibility in investment strategy. This paper proposes a new type of LTC product with a relatively low level of guarantee. The clients can choose their own investment strategies according to their own risk appetite.

2. RISK-SHARING STRATEGIES

Investment risk and insurance risk are the two major risks for an LTC product. If the actual investment performance is worse than the pricing assumption, it will cause a loss to the insurer. Any wrong assumptions of the claim rate, duration of benefit payment, and lapse rate can cause a loss as well. Insurers are the most experienced experts on insurance risk and therefore are comfortable to take the risk. Though insurance risk can be transferred by securitization in some cases, insurers are likely to retain it. On the other hand, investment risk is out of the control of insurers. The investment performance highly depends on the economic environment, monetary policy, fiscal policy, etc. The long duration of the liability and the uncertainty of the timing and amount of benefit payment make the exposure of LTC insurers to investment risk even higher. It is more critical to transfer the investment risk of insurers than insurance risk.

2.1 Strategies

Currently two types of risk-sharing strategies are adopted by the LTC carriers: adjustable premium and adjustable benefit.

1. Adjustable premium. The insurer can adjust the premium given a fixed amount of benefit. By comparing the actual experience to the pricing assumptions, the

premium can be increased or decreased. Not only investment experience, but also insurance experience can cause a premium change. However, this approach has a lack of transparency. Unless the premium adjustment follows a pre-specified rule, the clients may have a strong feeling of uncertainty. To mitigate this concern, the premium adjustment may be limited to a maximum percentage and there may be a cap on the premium rate.

2. Adjustable benefit. The insurer can adjust the benefit given a fixed amount of premium. The adjustment is usually based on some index that is linked to the investment performance or the inflation rate. This approach is more transparent than adjustable premium.

However, existing LTC products do not allow policyholders to choose their own investment strategies. Even with these risk-sharing arrangements, the implicit level of guarantee is still high. Insurers usually use conservative investment strategies to back the guarantees by investing mainly in fixed-income securities. Rising medical costs and inflation require a higher return to make the product affordable to the clients. Clients may also have a higher level of risk tolerance than that implied from the conservative investment strategies. Different clients may have different time horizons. Younger clients may want to invest in more risky assets and gradually move to less risky assets before the LTC benefit payment. This creates additional investment risk; but if shared with the clients, the price of the LTC product can be reduced and there is an upside potential for the clients. To limit the downside risk for the clients, the insurer can guarantee a lower level of benefit.

It is not uncommon to pass through investment risk in insurance products to clients. For example, defined-contribution plans, universal life (UL) products, variable universal life (VUL) products, and variable annuities (VAs) transfer the investment risk to clients to a significant extent. Some of them also offer low-level guarantees to protect the client from losing too much. These features include the minimum credit interest rate in UL products, and secondary guarantees such as guaranteed minimum accumulation benefit (GMAB), guaranteed minimum withdrawal benefit (GMWB) and guaranteed minimum income benefit (GMIB) in VA products. However, for these investment-oriented insurance products, clients have their own investment accounts. In the new design of the LTC product, which is a protection-oriented insurance product, clients do not have their own accounts. But like those investment products, investment risk is partially transferred to the clients with a low level of guarantee provided by the insurer. We have not seen any similar features for protection products in the market except John Hancock Benefit Builder (JHBB). However, JHBB does not allow clients to select their own investment strategies according to their individual risk

tolerance. There is also more flexibility in premium payments for clients in the new design.

Table 1 summarizes the major differences between the proposed product and the traditional LTC product. For the same amount of base benefit, the premium rates of both products are level and guaranteed. But the premium payment in the new design can be flexible so that policyholders can easily adjust their payments according to their changing financial conditions and insurance needs. It helps improve the lapse experience.

Table 1. New LTC Product Design

Product Features	Traditional LTC	New LTC
Benefit	Guaranteed	Adjusted according to actual premium payment and investment performance. A minimum LTC benefit guarantee applies but at a lower level than in a traditional LTC product.
Investment Strategy	Determined by insurers	Chosen by clients
Premium Rate per Base Benefit Amount	Level and guaranteed	Level and guaranteed
Premium Payment	Level and guaranteed	Flexible

Compared to other de-risking designs of LTC, such as the combo products and the accelerated death benefit (ADB), the new design is distinctive in three aspects:

- (1) Customers can choose their own investment strategies according to their own risk tolerance.
- (2) Customers can pay according to their own financial situation. The probability of losing coverage due to financial difficulties is reduced significantly.
- (3) The risk reduction is achieved by risk transferring rather than risk diversification or aggregation.

The new design has the flexibility of setting the LTC payment criteria to meet the requirements specified in the Health Insurance Portability and Accountability Act (HIPAA) to be tax-qualified. Or it could have less stringent payment triggers and offer

cash surrender values without being tax-qualified. This flexibility enables the new design to meet different needs of customers. It fits well to the current regulatory environment.

The benefit adjustment is the most complicated part of the new design. The benefit is adjusted based on a simple traditional LTC product with a level premium of \$X for T years and a base benefit of \$Y. The adjusted benefits under scheduled premium and flexible premium are discussed below.

Adjusted Benefit under Scheduled Premium

To start with, assuming that the actual premium payment follows the scheduled premium, the benefit of the new LTC is adjusted according to the investment performance. It can be determined using the following formula during premium payment period (0, T]. After the premium payment period, there will be no further benefit adjustment.

$$B_t = \text{Max} \left(Z, Y \cdot \frac{\sum_{i=1}^t (\prod_{j=i}^t (1 + r_j))}{\sum_{i=1}^t (\prod_{j=i}^t (1 + br))} \right), t \in (0, T]$$

where

B_t : Adjusted benefit amount at time t, $0 < t \leq T$.

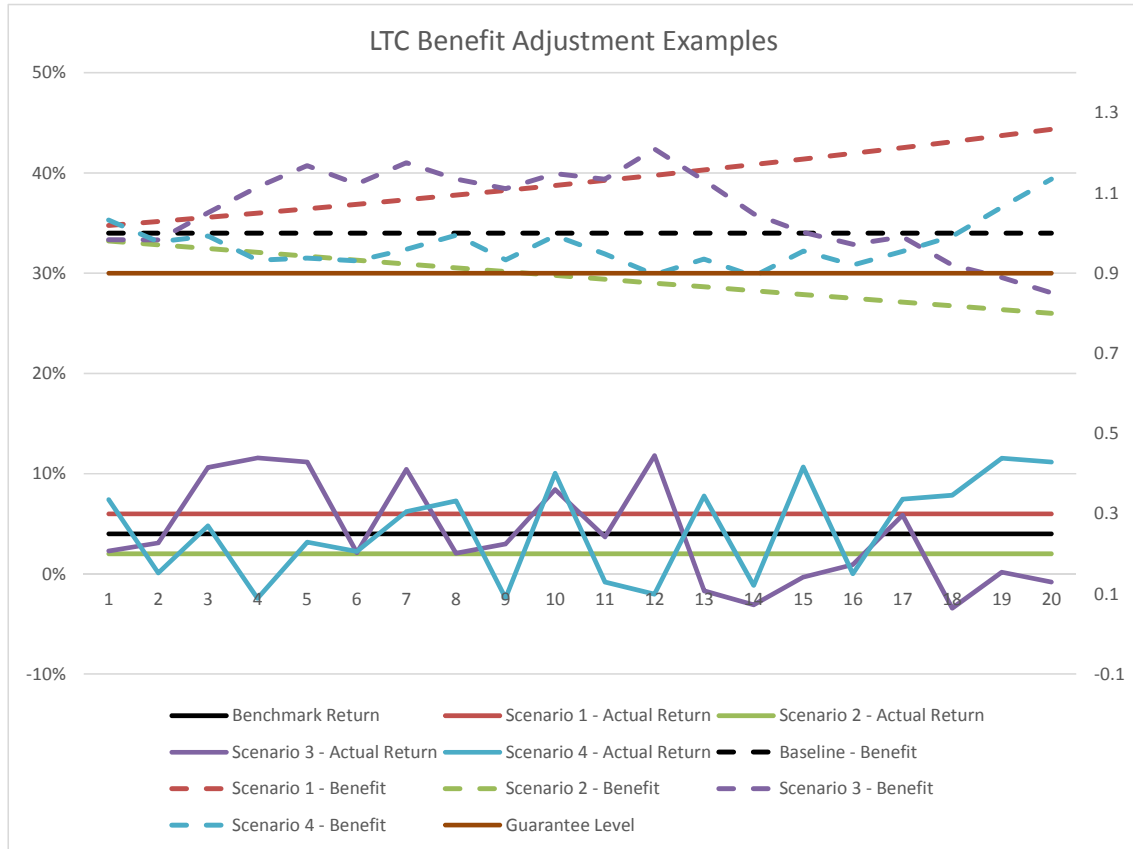
Z : The guaranteed minimum benefit amount. It can be presented as a portion of Y.

r_j : Actual investment return of the chosen investment portfolio in period j.

br : Benchmark return that represents the pricing interest rate of the traditional product.

By comparing the cumulative return of the actual investment portfolio to the benchmark return, the benefit amount is adjusted to pass the investment risk to clients. The benefit amount is floored to limit the downside risk for the clients.

Figure 1. New LTC Product: Benefit Adjustment with Fixed Premium Payment



Notes:

1. Primary axis: Benchmark return and actual returns.
2. Secondary axis: Level of benefit

Figure 1 illustrates the benefit adjustment ratio of the proposed LTC product under several scenarios. In this example, there are 20 level premium payments. The actual premium is paid as scheduled. The benchmark return is 4 percent. Four scenarios of investment returns are listed in Table 2. The adjusted level of benefit is highly correlated with the actual investment return. The level of benefit is measured as a multiple of that under the baseline scenario with a benchmark return of 4 percent. The benefit is guaranteed to be no less than 90 percent of the baseline level. With the benefit adjustment, investment risk will be partially transferred to policyholders. However, the downside risk for the policyholders is limited as the benefit amount is floored.

Table 2. Investment Return Scenarios

Term	Benchmark Return	Scenario 1 – Actual Return	Scenario 2 – Actual Return	Scenario 3 – Actual Return	Scenario 4 – Actual Return
1	4%	6%	2%	2%	7%
2	4%	6%	2%	3%	0%
3	4%	6%	2%	11%	5%
4	4%	6%	2%	12%	-2%
5	4%	6%	2%	11%	3%
6	4%	6%	2%	2%	2%
7	4%	6%	2%	10%	6%
8	4%	6%	2%	2%	7%
9	4%	6%	2%	3%	-2%
10	4%	6%	2%	8%	10%
11	4%	6%	2%	4%	-1%
12	4%	6%	2%	12%	-2%
13	4%	6%	2%	-2%	8%
14	4%	6%	2%	-3%	-1%
15	4%	6%	2%	0%	11%
16	4%	6%	2%	1%	0%
17	4%	6%	2%	6%	7%
18	4%	6%	2%	-3%	8%
19	4%	6%	2%	0%	12%
20	4%	6%	2%	-1%	11%

Adjustable Benefit under Flexible Premium

When the actual premium payment is different from scheduled, the benefit is adjusted according to the actual premium payment. Intuitively, the adjustment can be calculated using the following formula. Both the premium payments and the actual investment performance are incorporated in the benefit amount determination.

$$B_t = \text{Max} \left(Z'_t, Y \cdot \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + r_j))}{\sum_{i=1}^t (X \cdot \prod_{j=i}^t (1 + br))} \right), t \in (0, T]$$

$$Z'_t = \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + br))}{\sum_{i=1}^t (X \cdot \prod_{j=i}^t (1 + br))}$$

where

B_t : Adjusted benefit amount at time t, $0 < t \leq T$.

Z_t : The guaranteed minimum benefit amount at time t.

Z : The guaranteed minimum benefit amount when the premium payments are level and equal to X. It is lower than Y, the corresponding benefit amount of the traditional LTC product.

P_i : Flexible premium payment at time i.

r_j : Actual investment return of the chosen investment portfolio in period j.

br : Benchmark return that represents the pricing interest rate of the traditional product.

Table 3 illustrates the benefit adjustments under two scenarios where premium payments are different from scheduled. In scenario 1, the client pays less than scheduled in the first 10 years and pays more thereafter. The benefit ratio is less than 100 percent and gradually goes up in the last 10 years. In scenario 2, the client overpays in the first 10 years. The benefit is greater than 100 percent and is reduced gradually in the last 10 years. In this example, we assume the actual investment return is the same as the benchmark return.

Table 3. Benefit Adjustment Caused by Flexible Premium Payment

Policy Year	Scenario 1			Scenario 2	
	Scheduled Premium	Premium Payment	Benefit Ratio	Premium Payment	Benefit Ratio
1	500	400	80.0%	700	140.0%
2	500	400	80.0%	700	140.0%
3	500	400	80.0%	700	140.0%
4	500	400	80.0%	700	140.0%
5	500	400	80.0%	700	140.0%
6	500	400	80.0%	700	140.0%
7	500	400	80.0%	700	140.0%
8	500	400	80.0%	700	140.0%
9	500	400	80.0%	700	140.0%
10	500	400	80.0%	700	140.0%
11	500	600	83.0%	300	134.1%
12	500	600	85.4%	300	129.1%
13	500	600	87.5%	300	125.0%
14	500	600	89.3%	300	121.4%
15	500	600	90.8%	300	118.4%
16	500	600	92.2%	300	115.7%
17	500	600	93.3%	300	113.3%
18	500	600	94.4%	300	111.3%
19	500	600	95.3%	300	109.4%

20	500	600	96.1%	300	107.7%
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However, this design is subject to the risk of dynamic premium payment. In the two scenarios, the clients pay the same total amount of premium. However, in the second scenario, the benefit amount during the premium payment period is much higher. An extreme scenario would be that the client pays a single premium of \$10,000 and the benefit amount in the first year is 20 times the base benefit amount. This certainly is not fair and leads to a big exposure to premium payment risk.

We can add a little bit more complexity to mitigate this risk. If the accumulated value of the paid premium payments till the valuation date is less than the accumulated value of scheduled level premium payments till the valuation date, the benefit is adjusted down. At the valuation date, if the paid premium payments accumulated till the end of the premium payment period are greater than the accumulated value of scheduled level premium payments till the end of the premium payment period, the benefit is adjusted up. Otherwise, the benefit stays unchanged. The formulas are given below.

$$B_t = \text{Max}(Z'_t, Y \cdot R_t)$$

$$R_t = \begin{cases} \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + r_j))}{X \sum_{i=1}^t (1 + br)^{t-i+1}} & \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + r_j))}{X \sum_{i=1}^t (1 + br)^{t-i+1}} < 1 \\ \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + r_j)(1 + br)^{T-t})}{X \sum_{i=1}^T (1 + br)^{T-i+1}} & \frac{\sum_{i=1}^t (P_i \cdot \prod_{j=i}^t (1 + r_j)(1 + br)^{T-t})}{X \sum_{i=1}^T (1 + br)^{T-i+1}} \geq 1 \\ 1 & \text{Others} \end{cases}$$

$$Z'_t = R_t \cdot Z$$

where

t: Current time.

R_t: Benefit adjustment ratio.

B_t: Adjusted benefit amount at time t, 0 < t ≤ T.

Z_t': The guaranteed minimum benefit amount.

Z: The guaranteed minimum benefit amount if the premium payments are level and equal to X. It is lower than Y, the corresponding benefit amount of the traditional LTC product.

P_i : Flexible premium payment at time i .

r_j : Actual investment return of the chosen investment portfolio in period j .

br : Benchmark return that represents the pricing interest rate of the traditional product.

Continuing with the two scenarios in Table 3, Table 4 illustrates the benefit adjustment using the new method. In scenario 1, the benefit adjustment stays the same as before. In scenario 2, the client overpays in the first 10 years. Until the 17th year, the total actual premium payments are less than the total scheduled premium payments on the accumulated basis. Therefore, the benefit ratio is equal to 100 percent for the first 16 years. After that, the benefit amount is adjusted up accordingly.

Table 4. Benefit Adjustment Caused by Flexible Premium Payment—New Design

Policy Year	Scheduled Premium	Scenario 1		Scenario 2		Scenario 3	
		Premium Payment	Benefit Ratio	Premium Payment	Benefit Ratio	Premium Payment	Benefit Ratio
1	500	400	80.0%	700	100.0%	700	100.0%
2	500	400	80.0%	700	100.0%	700	100.0%
3	500	400	80.0%	700	100.0%	700	100.0%
4	500	400	80.0%	700	100.0%	700	100.0%
5	500	400	80.0%	700	100.0%	700	100.0%
6	500	400	80.0%	700	100.0%	700	100.0%
7	500	400	80.0%	700	100.0%	700	100.0%
8	500	400	80.0%	700	100.0%	700	100.0%
9	500	400	80.0%	700	100.0%	700	100.0%
10	500	400	80.0%	700	100.0%	700	100.0%
11	500	600	83.0%	300	100.0%	700	100.0%
12	500	600	85.4%	300	100.0%	700	100.0%
13	500	600	87.5%	300	100.0%	700	102.9%
14	500	600	89.3%	300	100.0%	700	108.8%
15	500	600	90.8%	300	100.0%	700	114.5%
16	500	600	92.2%	300	100.0%	700	120.0%
17	500	600	93.3%	300	101.5%	700	125.3%
18	500	600	94.4%	300	103.6%	700	130.4%
19	500	600	95.3%	300	105.7%	700	135.3%
20	500	600	96.1%	300	107.7%	700	140.0%

However, there is a potential issue with this approach as well. If a client wants more LTC benefit and plans to pay \$700 each year for 20 years, he cannot get the 1.4 times benefit as expected until the end of the premium payment period. This sounds unfair to the client. After 13 years, the aggregate amount of actual premium payments

exceeds the total scheduled premium on the accumulated basis. The benefit ratio will then climb to 140 percent in the 20th year. But this issue can be addressed by allowing the client to adjust the base benefit amount and the corresponding scheduled premium payments, given that it meets the underwriting requirements.

2.2 Investment

In the new design, policyholders can choose their own investment strategies according to their risk tolerance. Younger policyholders may choose a risky investment strategy and move gradually to a safe investment strategy. Instead of investing mostly in fixed-income securities as for traditional products, other asset classes such as equity, real estate or Treasury Inflation Protected Securities (TIPS) can be used to gain a higher expected return to combat the rising medical costs. Complicated strategies can also be used to determine the appropriate asset allocation according to the level of risk tolerance. A possible example is given below. Table 5 lists the major assumptions.

Table 5. Dynamic Investment Strategy—Assumptions

	Assumptions
Asset Classes	Bond and equity
Premium Payment	Level
Risk Tolerance	The probability that the LTC benefit is less than G% of the base benefit is no greater than 1-p.
Portfolio Rebalance	Annual rebalance at the time of premium payment. In practice, it could be daily rebalance to minimize the hedging error.

The asset mix according to the risk tolerance can be derived as below.

$$Pr[(w_t \cdot S_{T-t} + (1 - w_t) \cdot B_{T-t}) < K_t] = 1 - p$$

$$S_{T-t} = e^{(\mu - 1/2\sigma^2)(T-t) + \sigma \cdot W_{T-t}}$$

$$B_{T-t} = e^{R_{T-t}(T-t)}$$

$$K_t = \frac{\sum_{i=1}^t (\prod_{j=i}^t (1 + br))}{\sum_{i=1}^t (\prod_{j=i}^t (1 + r_j))} (1 + br)^{T-t} \cdot G\%$$

where

T: Maturity date.

t: Rebalance date.

T-t: Remaining maturity.

μ : Expected growth rate for equity.

σ : Real-world volatility for equity.

p: Confidence level.

r_j : Actual investment return of the chosen investment portfolio in period j.

G%: The guarantee level as a percentage of the base benefit amount.

R_{T-t} : Spot rate at time t for a term of T-t.

W_{T-t} : Wiener process.

w_t : Weight on equity at time t.

It can be solved using the following method.

$$\Pr[S_{T-t} < \hat{S}_{T-t}^{1-p}] = 1 - p$$
$$\hat{S}_{T-t}^{1-p} = e^{(\mu - 1/2\sigma^2)(T-t) + \sigma\sqrt{T-t}\Phi^{-1}(1-p)}$$

where

$\Phi^{-1}(U)$: The inverse of the cumulative distribution function of standard normal distribution.

$$w_t \cdot \hat{S}_{T-t}^{1-p} + (1 - w_t) \cdot B_{T-t} = K_t \Rightarrow w_t = \frac{B_{T-t} - K_t}{B_{T-t} - \hat{S}_{T-t}^{1-p}}$$

The new LTC product with different investment strategies is analyzed regarding the risk transfer and risk profile using numerical examples in the next section.

3. NUMERICAL EXAMPLE

In this section, the risk of the new, designed LTC product is compared with a traditional LTC product with similar features. As our goal is to assess the risk, some product features and assumptions are simplified if they are not relevant to investment risk. Tables 6 and 7 list the product information and profit-testing assumptions.

Table 6. LTC Example: Product Specification

Product Specification	
Issue Age	50
Gender	Male
Premium Payment Period	20 Years
Benefit Period	Till age 99

Traditional Product	
Monthly LTC Benefit	\$3,000
Fixed Annual Premium	\$443.6
New Product	
Monthly Base LTC Benefit	\$3,000
Monthly Guaranteed Minimum LTC Benefit	\$2,400
Scheduled Annual Premium	\$443.6
Actual Annual Premium	\$443.6

Table 7. LTC Example: Profit-Testing Assumption

Profit-Testing Assumption		
Insurance Assumption		
Mortality	Based on 1984-2007 Long Term Care Intercompany Study	
Lapse	Based on 1984-2007 Long Term Care Intercompany Study	
LTC Incidence Rate	Based on 1984-2007 Long Term Care Intercompany Study	
Average Length of LTC Claim	11 months based on the median of the experience data (1984-2007 Long Term Care Intercompany Study)	
Economic Assumption⁴		
Initial Yield Curve	Term	Risk Free Rate (%)
	1	0.3
	2	0.64
	3	1.05
	4	1.54
	5	2.03
	7	2.74
	10	3.42
	20	4.22
30	4.35	
Interest Rate Model	One-factor Hull White model ($\sigma=10\%$, $\alpha=0.05$)	
Equity Model	Log-normal model (Equity risk premium = 6%, $\sigma = 25\%$)	
Correlation between Interest Rate and Equity Return	10%	

Based on the economic assumptions, 1,000 stochastic scenarios are generated, and

⁴The economic assumptions used are for illustration purposes. They are based on the same framework used in Shang et al. "Pension Plan Embedded Option Valuation" (2013). Details are not listed here as they are not the focus of this paper.

possible outcomes of the two products under these scenarios are compared.

1. All assets are invested in a bond fund with a duration of 10 years.

It is a conservative investment strategy with a low volatility. Table 8 lists the information about the benefit amount and the profit. From the clients' perspective, the expected benefit amount of the new product is about 11 percent higher than that of the traditional product. The benefit amount can go up or down, but it has a big upside potential than downside risk, as it is floored at a guaranteed level of \$2,400. From the LTC carrier's perspective, the downside risk of the present value of profit is much smaller for the new product. The risk is measured by the left tail (LT) conditional tail expectation (CTE), which is the average of the extreme losses greater than a specified percentile. The required economic capital can be calculated as the difference between the CTE and the average value. Using LT CTE (99) – Average as the economic capital, the traditional product requires about 94 percent more economic capital than the new product to support the investment risk. It demonstrates that investment risk has been partially transferred in the new product.

Table 8. LTC Product Comparison: 100 Percent Bond Investment

	New Product	Traditional Product
Monthly Benefit Amount @ Age 70		
Average	3,333.5	3,000
Maximum	6,089.7	3,000
Minimum	2,400.0	3,000
Present Value of Future Profit (PVFP)		
Average	706	847
Maximum	3,105	3,814
Minimum	-270	-1,370
Left Tail CTE (95)	-97	-453
LT CTE (95) – Avg.	-803	-1,300
Left Tail CTE (99)	-208	-926
LT CTE (99) – Avg.	-914	-1,773

2. Fifty percent bond investment and 50 percent equity investment.

With the design of the new product, the clients can choose their investment strategies according to their risk tolerances. They are able to choose some risky strategies so that the expected benefit amount can keep up with the rising inflation rate and medical cost. This is especially true for clients with a long investment horizon. For the traditional product, risky strategies may not be possible given the risk that LTC carriers have to take. In Table 9, we can see that the upside potential for the benefit amount is much higher than that under the conservative investment strategy. The new product is much less risky than the traditional product for the LTC carrier.

Table 9. LTC Product Comparison: 50 Percent Bond/50 Percent Equity

	New Product	Traditional Product
Monthly Benefit Amount @ Age 70		
Average	4,962.6	3000
Maximum	18,807.9	3000
Minimum	2,400.0	3000
Present Value of Future Profit (PVFP)		
Average	4,522	7,108
Maximum	75,097	129,482
Minimum	-7,654	-8,999
Left Tail CTE (95)	-1,433	-1,699
LT CTE (95) – Avg.	-3,750	-4,979
Left Tail CTE (99)	-3,750	-4,979
LT CTE (99) – Avg.	-8,272	-12,087

3. Dynamic investment strategy described in Section 2.2.

With the dynamic investment strategy, the risk for the LTC carrier is highly reduced, compared to the 50 percent bond/50 percent equity investment strategy. The expected profit is lower because the dynamic investment strategy is similar to a portfolio insurance strategy that sells low and buys high. Lower profit is consistent with lower risk. If the company wants to achieve the same level of profit regardless of the investment strategy chosen by the client, it can adjust the fund charge to achieve it.

Table 10. LTC Product Comparison: Dynamic vs. 50 Percent Bond/50 Percent Equity

	50% Bond/ 50% Equity	Dynamic (Less than 5% prob. that the minimum LTC benefit guarantee is in-the-money)
Monthly Benefit Amount @ Age 70		
Average	4,962.6	4,903.47
Maximum	18,807.9	32,655.64
Minimum	2,400.0	2,400.00
Present Value of Future Profit (PVFP)		
Average	4,522	1,187
Maximum	75,097	12,649
Minimum	-7,654	-3,470
Left Tail CTE (95)	-1,433	-818
LT CTE (95) – Avg.	-3,750	-2,005
Left Tail CTE (99)	-3,750	-2,003
LT CTE (99) – Avg.	-8,272	-3,190

The new design is less risky than the traditional design for all the tested strategies. It floors the benefit amount for clients while at the same time it provides a high upside potential. The new design provides a way of finding the most appropriate risk-return trade-off for both the clients and the insurers.

4. EFFECTIVENESS AND CHALLENGES

While the new LTC design provides a risk-sharing solution and allows flexibility in the investment strategy, it also has some challenges for a successful implementation.

1. The benefit adjustment feature may be difficult for clients to understand. Sufficient disclosure and communication are required when selling the product. Clients need to be aware of the possible outcomes under different scenarios, especially adverse scenarios. Otherwise, it may create reputational risk for the

insurer. Insurers selling VAs with complex guarantee features have the experience for such kind of communication and marketing. To reduce the complexity of benefit adjustment, flexible premium payment may be disallowed.

2. Some clients may not be comfortable with choosing their own investment strategies. They may not have the knowledge or time to make the right decision according to their own situation. Advisers need to be trained so that they can make professional recommendation to the clients. The insurer can also make some preset investment strategies for clients to choose. Those investment strategies may reflect different levels of risk tolerance.
3. Even though the level of guarantee is lower than that offered by a traditional product, it still has a cost. Different investment strategies lead to different costs of guarantee. This may make the product more complicated and create a burden on the administration system. One possible solution is to only provide several investment strategies instead of allowing clients to choose from a wide range of investment options. The charge for the cost of guarantee can be determined and disclosed to the client for the offered investment strategies.

Communication is the key to overcoming these difficulties. As long as the clients understand the upside and downside potential of this new product, the exposure to reputational risk can be managed.

5. CONCLUSION

The proposed new design of the LTC product allows the partial transfer of investment risk to clients. This makes the product more affordable and reduces the insurer's risk exposure significantly. Clients can also choose appropriate investment strategies according to their risk tolerance. More risky assets that have higher expected returns may be bought and used to hedge the rising medical cost and inflation rate. These features make the new product attractive to young clients.

However, it is important to make sure that clients understand the return and risk of the new product to mitigate reputational risk. Further tests in the LTC insurance market are needed to refine the design.

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