Using Life Settlements to Hedge the Mortality Risk of Life Insurers: an Asset-Liability Management Approach

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Introduction

- Longevity risk represents a critical threat to pension funds and life insurers.
- We also witnessed the increasing frequency of pandemics and catastrophes that caused sudden, significant payments of death benefits.
- Differnt products sold by life insurers are exposed to the longevity risk and the mortlaity risk to different degrees.
- The unceratin cashflows may cause short-term liquidity shocks as well as long-term solvency threats to the life insurance companies.

Introduction---Literature Review

1. Capital market solution:

- mortality securitization , survivor bonds and survivor swaps.

2. Industry self-insurance solution:

- the nature hedging strategy, duration matching strategy, and Conditional Value at Risk approach.

3. Mortality projection improvement

- continuous-time frameworks
- discrete-time frameworks
- the parameter uncertainty and model specification on mortality process

Introduction

- In the real practices, life insurance companies may have difficulties to implement natual hedging strategy because they are not able to allocate insurance liability accordingly.
- Hedging the longevity risk and the mortality risk from the asset side may be more flexible and cost-effective than through the liability side.
- Life settlements and its related securitizations have provided an efficient tool for life insurers to achieve this goal. Moreover, life settlements can be good investments to life insurance companies since they offer good yields with near-zero betas.
- Nevertheless, little research has been doneon developing an efficient hedging mechanism using life settlements.

Life Settlements Market

Life settlements is becoming an increasingly popular asset class, offering good returns that are largely unaffected by financial crises and market downturns like those of 2000 and 2008.

The Growth of the Life Settlement Market

YEAR	TOTAL FACE AMOUNT SOLD
1998	$200 million
2006	$5.5 billion
2008	$12.95 billion
2009	$7.01 billion

Important Characteristics :

- Largely uncorrelated performance, Potentially attractive risk/return profile, Relatively low volatility, Superior credit quality.

Contributions of the Paper

- We propose an approach to evaluate the hedgeing effect of life settlements for the mortality risk of life insurance products.
- We adopt the pool of real life setttlements data from the Coventry.
- We demonstrate that the life settlements help to provide a hedge effect to mitigate the mortality risk.
- Life settlements can be regarded as an effective hedging vehicle to reduce the aggregate risk significantly for life insurance companies and such hedging activities can be arranged with low costs.

Basic setting for life settlements

- n senior life settlements
- t_i : life expectancy of the i-th life settlement, $i = 1, 2, \ldots, n$
- T_i : The extension in actual life beyond expectancy of *the* i-th life settlement

Value of life settlements

- $V_i(t_i)$
- $EV_i(t_i + T_i)$.

- It depends on the internal rate of return r_2, premium schedule, and death benefit.

Basic setting for life contracts

- m life contracts
- s_j : life expectancy of the j-th life contract, $j = 1, 2, \ldots, m$
- τ_j : the deviation from expectancy of *the* j-th life contract

Value of life contracts

- $W_i(\tau_i)$
- $EW_i(s_i + \tau_i)$.

- It depends on discount rate r_1 , premium schedule, and death benefit.

Joint distribution of τj and Ti

- Normal factor copula

$$T_i = F_i^{-1}(N(X_i)), \qquad i = 0, 1, \dots, n$$

$$\tau_i = E_i^{-1}\left(N\left(Y_j\right)\right), \qquad j = 0, 1, \dots, m$$

- $X_i = aZ + \sqrt{1 - a^2} Z_i, \quad i = 1, 2, \dots, n.$
- $Y_j = bZ + \sqrt{1 - b^2} M_j,$ j = 1, 2, ..., m

Numerical examples

- The pool of life settlements consisting life policies of 213 senior males from Convertry.
- The insurer has a liability portfolio with 500 homogeneous whole life policies of senior males at age 65. Each policy has death benefits 1,000,000 and no future premium to be collected.
- Numerical results are based on 1000 scenarios.

Marginal distributions of τj and Ti

- Fit the marginal distribution function of t_i+T_i by the Heligman-Pollard law.
- The value of parameter G = 0.000002 The resulted range of the values of H is from 1.1296 to 1.1699.
- The residual life of the policy holders are assumed to be governed by the Heligman-Pollard law as well with parameter values G = 0.000002 and H = 1.13451

Notations

- the internal rate of return of life settlement pool is r_2 and the discount rate for insurer's liability pool is r_1.
- The standard deviations of the value of the insurer's liability pool, life settlement pool, and their combination are denoted by σ_1, σ_2, and σ_h, respectively.

Hedging Efficiency

- When the values of the insurer's liability pool and life settlement pool are independent,

  $\sigma_h^2 \quad \approx \; \sigma_1^2 + \sigma_2^2.$

- Use

$$\eta = 1 - \sigma_h^2 \;\; /(\sigma_1^2 + \sigma_2^2)$$

as a proxy of the effectiveness of natural hedge in the hedge program.

Simulation Results
r1 = 0.08 and r2 = 0.12

a	b	σ_1	σ_2	σ_h	η
0.1	0.1	9105004	36279664	31225975	30%
0.1	0.3	24483192	35622983	25594507	65%
0.1	0.5	43529240	36536850	31843047	69%
0.1	0.7	60532055	35809806	44827027	59%
0.1	0.9	79076482	36470829	60957502	51%

Simulation Results
r1 = 0.08 and r2 = 0.12

a	b	σ_1	σ_2	σ_h	η
0.3	0.1	8866831	80255580	72869519	19%
0.3	0.3	25596836	82621543	59196683	53%
0.3	0.5	43678537	83579455	44516446	78%
0.3	0.7	59284328	82235133	35944864	87%
0.3	0.9	81285665	84136379	35181117	91%

Simulation Results
r1 = 0.08 and r2 = 0.12

a	b	σ_1	σ_2	σ_h	η
0.5	0.1	8971983	127221072	119507558	12%
0.5	0.3	25706155	133098430	108255940	36%
0.5	0.5	41467730	130952612	90856145	56%
0.5	0.7	57470723	127485745	73298976	73%
0.5	0.9	80790731	137001572	65720756	83%

r1 = 0.08 and r2 = 0.12

a	b	σ_1	σ_2	σ_h	η
0.7	0.1	9363347	182856304	174606900	9%
0.7	0.3	26030816	188995725	163530415	27%
0.7	0.5	40933444	179909473	139674728	43%
0.7	0.7	61594176	187090760	127329405	58%
0.7	0.9	78323735	183968297	110470310	69%

Simulation Results
r1 = 0.08 and r2 = 0.12

a	b	σ_1	σ_2	σ_h	η
0.9	0.1	9474292	249363316	240950285	7%
0.9	0.3	25051934	239521497	215059762	20%
0.9	0.5	40364717	232220519	192334329	33%
0.9	0.7	59373460	238129882	179742551	46%
0.9	0.9	82179967	242145045	163289062	59%

Conclusion

- From simulation results, we find that the values of the hedge effect in all Tables are all less than 1. It implies that life settlements can serve as an effective hedging vehicle for hedging mortality risk.
- We also find the different combinations of *a* and *b* generate different hedging effects.
- Our research approach can help life settlement companies and life insurers to structure better products in term of asset liability management purpose for life insurance companies.
- We demonstrate that the proposed hedging strategy can help life insurers to better utilize life settlements in hedging the mortality risk.

Conclusion

- This paper investigates the hedge effects of the life settlements for life insurance companies from the asset-liability management perspective.
- We propose an hedging approach to evelate hedging effects of life settlement for hedging the mortality risks of life insurance companies.
- Our numerical results show that the proposed hedging strategy can help life insurers to better utilize life settlements in hedging the mortality risk. Therefore, life settlements can be regarded as an effective hedging vehicle to reduce the aggregate risk of the life insurers.

Future Works

- Use data in the real practices from life insurance company and life settlements to generate the correlation parameters of a and b in our model.
- Adopt the stochastic mortality model (such as Cairns et al., 2006b, the CBD model) to construct future mortality processes and corresponded liability distributions.
- Further analyze and discuss the basis risk of using life settlements.

Thank you