The Life Care Annuity

A New Empirical Investigation of an Insurance Innovation

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Agenda

- Motivation
- Literature Review
- Data and Methods
- Results
- Further Discussion

- The views presented here do not represent those of the U.S. Treasury Department.

Motivation: Current Market Problems

- Life Annuity
  - Adverse Selection
  - Psychological Aversion
  - Consumer Welfare and Public Policy Advantages
- Long-term Care Insurance (LTCI)
  - Extensive and Strict Underwriting
  - Lapses
  - Consumer Welfare and Public Policy Advantages
- Life Care Annuity as a Solution
  - Integrated Product
  - Empirical Hypotheses
  - Alternatives?
- Focus on Market and Product Fundamentals
  - Ignore Public Welfare Programs (e.g. Medicaid)
  - Largely Ignore Taxes (but see Brazell, Brown and Warshawsky (2009))
  - Consideration of Some LTCI Industry Practices: Level Periodic Premium, and Unisex Pricing

Literature Review

- Murtaugh, Spillman and Warshawsky (2001) (MSW)
  - Combined Product Increases Potential Market from 77 to 98 percent for 65-year-olds
  - Cost of $1K Monthly Life Annuity Segment (with 3% Annual Increase) Declines from $187,102 to $178,426 (unisex)
  - Cost of $2K + $1K Monthly LTCI Segment (with 5% Annual Increase) Declines from $43,049 to $40,342
  - Based on 1986 NMFS, Weighted to Population, Projected to 1995
  - Robustness Tested, but No Expected Utility Model Available or Lapses Considered
- Brown and Finkelstein (2007)
  - Evaluates Actuarial Fairness of LTCI in Market
  - Load of 0.18 without Lapses, 0.51 with Lapses
  - Load Much Higher for Men
  - Used Robinson Model of Transition Probability Matrix, Based on NLTCS
- Brown and Finkelstein (2008)
  - Expected Utility Intertemporal Model for Individuals (CRRA)
  - Medicaid, although second-best, crowds out LTCI
  - Additional Willingness to Pay – For Women, $41,600, for Men, $25,600 for Typical LTCI Policy; $140,900 and $88,700, respectively, for Comprehensive Policy
- Annuity Literature, e.g. Warshawsky (2007) and MPWB (1999)

Empirical Task

- Calculate actuarially fair prices of different products (LTCI, life annuity, and combined products) for groups distinguished by risk.
- Focus is on the retiree population, yet retirement (65+) can span 40 years.
- No sources of data extend 40 years and include all of the risk determinants in which we're interested.
- Solution: Use a panel dataset covering a shorter period of time, and match people according to individual characteristics to simulate health/disability transitions over longer time periods.

Our approach

- Use continuous-time Markov chains (CTMC) to estimate transitions between health and disability states of groups based on age, gender, health status, and disability status
- Simulate disability incidence and duration, as well as mortality, using estimated transition rates.
- Calculate actuarially fair premiums for various products based on projected disability and mortality.

Data: Health and Retirement Study

- Panel survey of population 50+
  - Conducted (more or less) every two years since 1992.
  - Original HRS cohort merged with Asset and Health Dynamics among the Oldest Old (AHEAD), with the age gap filled by the HRS War Baby and Children of Depression cohorts beginning in 1998. Early Baby Boomers added in 2004.
- Individuals or their proxies interviewed until death.
- Contains detailed information on health status and history (including self-assessment), disability (physical and cognitive), income, assets, employment (current and historical), and mortality.
- This analysis uses HRS data from 1998 through 2008.

Sample

- 50,591 observations
- Divided into groups by gender, age (65-69, 70-74, 75-79, 80-84, 85-89, 90+)
- Further categorized by health/disability status, with categories determined by likelihood of next period disability or death.
- Disability/health status categories also consistent with common underwriting standards in the LTCI market and assumed operation of adverse selection in annuity market.

Health/disability groups

Risk Category	History of Major Illness	Self-Reported Health	Disability Status	Pass LTCI Underwriting?
E0	None	Good to Excellent	not disabled	Likely
N0	None	Fair to Poor	not disabled	Uncertain
L0	Heart Problems or Diabetes, but not both	All	not disabled	Uncertain
H0	Heart Problems and Diabetes, or Lung Disease, or Stroke	All	not disabled	Highly Unlikely
N2	None	All	moderately disabled	No
L2	Heart Problems or Diabetes, but not both	All	moderately disabled	No
H2	Heart Problems and Diabetes, or Lung Disease, or Stroke	All	moderately disabled	No
N4	None	All	severely disabled	No
L4	Heart Problems or Diabetes, but not both	All	severely disabled	No
H4	Heart Problems and Diabetes, or Lung Disease, or Stroke	All	severely disabled	No

Major illness includes heart problems, diabetes, lung disease, and stroke

Heart problems include history of heart attack, coronary heart disease, angina, convestive heart failure, or other heart problems

Lung disease includes history of chronic lung diseases like chronic bronchitis and emphysema but not asthma

Stroke includes history of stroke or transient ischemic attack

Not disabled refers to 0-1 ADL limitations and no cognitive impairment

Moderately disabled refers to 2-3 ADL limitations or cognitive impairment with fewer than 2 ADL limitations

Severely disabled refers to 4-5 ADL limitations of cognitive impariment with 2 or more ADL limitations

Data summary

	All (n=50,591)			65 year olds (n=2,063)		
	Both sexes	Male (42.7%)	Female (57.3%)	Both sexes	Male (47.4%)	Female (52.6%)
Risk Category						
E0	40.1%	36.8%	42.6%	54.6%	51.2%	57.7%
N0	7.0%	6.2%	7.6%	6.9%	6.2%	7.6%
L0	21.4%	25.8%	18.2%	17.9%	21.5%	14.6%
H0	17.7%	20.6%	15.6%	14.0%	15.0%	13.0%
Not disabled	86.3%	89.3%	84.0%	93.4%	93.9%	92.9%
N2	2.5%	1.8%	3.1%	2.2%	2.1%	2.3%
L2	1.9%	1.5%	2.2%	0.6%	0.5%	0.7%
H2	3.3%	3.0%	3.6%	1.9%	1.7%	2.1%
Moderately disabled	7.8%	6.3%	8.9%	4.7%	4.3%	5.1%
N4	1.4%	0.8%	1.9%	0.3%	0.4%	0.3%
L4	1.2%	0.8%	1.4%	0.4%	0.2%	0.6%
H4	3.3%	2.7%	3.8%	1.1%	1.2%	1.0%
Severely disabled	5.9%	4.4%	7.1%	1.9%	1.8%	2.0%

Transition probability matrices

- Transition probabilities calculated among health/disability statuses between period one and period two for each age/gender subsample, forming transition probability matrices.
- Two years between each observation.
- Death is the absorption state.
- We will now focus on transitions for the four non-disabled states.

Methodology: Continuous Time Markov Chains

- Assume transitions are determined by a time-homogeneous CTMC.
  - Key assumptions:
    - Only current state determines future state (not prior transitions).
    - Transition rates are constant over time.
- Transition rates (monthly) are then related to transition probabilities (spanning ~2 years) by the following:

$$P(s,x,t_1,t_2) = e^{(t_2-t_1)*R(s,x)}$$

  - $P(s,x,t_1,t_2)$ is the transition probability matrix between period 1 and 2 for gender s and age group x
  - R(s,x) is the monthly transition rate matrix
- Transition rate matrices yield all the information necessary to calculate the evolution of health and disability from the beginning of retirement until death.

Examples of estimation results: Observed versus fitted two-year transition probabilities for females 65-69 and males 75-79

		Female			
		Disabled		Dead	
Age Group	Risk Category	Observed	Estimated	Observed	Estimated
65-69	1	1.4%	1.9%	1.1%	1.2%
	2	9.1%	5.4%	3.3%	3.3%
	3	5.8%	3.7%	2.4%	2.8%
	4	9.2%	5.9%	5.8%	5.1%

		Male			
		Disabled		Dead	
Age Group	Risk Category	Observed	Estimated	Observed	Estimated
75-79	1	3.9%	4.6%	4.3%	4.5%
	2	14.4%	11.4%	12.0%	12.0%
	3	5.7%	6.7%	7.6%	8.5%
	4	10.5%	10.8%	14.2%	15.0%

How does starting health status shape disability incidence and duration?

- We want to know whether people with impaired initial health characteristics at retirement have greater expected LTC needs, or if their LTC needs are the same but sooner.
- To answer that, we simulate the disability/health transitions from the beginning of retirement (age 65) until death.
  - 20,000 simulations for each starting health status and gender
  - Quantifying and valuing disability:
    - Use monthly transition rates to determine transitions between health states.
    - Assume disability costs $4,000/month for moderate/severe disability.
      - Also look at an additional $2,000/month for severe disability.
    - Increase disability costs by five percent/year (typical increase in inflation-adjusted LTCI policies).
    - Assume discount rate is six percent/year.
    - For level premium policies, assume lapse rates equal to Society of Actuaries experience study on LTCI policies.
    - Determine cost of disability in lump-sum terms (akin to a single-premium LTCI policy) and in monthly annuitized amounts (akin to a level-premium LTCI policy).
      - Monthly annuitized amounts are calculated over remaining life expectancy.

Mortality and disability projections

	Male Risk Category					Female Risk Category				
	1	2	3	4	1-4	1	2	3	4	1-4
Life Expectancy	82.0	79.8	79.4	75.4	80.2	84.6	80.3	81.3	78.4	82.9
Months of moderate disability	23.1	22.8	21.4	20.9	22.3	32.3	28.0	33.4	32.5	32.1
Months of severe disability	9.2	9.2	7.8	8.6	8.8	15.7	13.8	15.4	15.8	15.5
Average age of first disability, conditional on becoming disabled	78.6	76.7	76.5	72.7	77.0	80.5	78.3	75.6	73.8	78.6
Percent ever disabled	69%	65%	66%	57%	66%	70%	58%	80%	68%	69%
Percent disabled 3+ years	25%	25%	23%	23%	24%	34%	29%	36%	34%	33%

Actuarial cost of LTCI disability insurance policies, by gender and starting health

	Male					Female				
	Risk Category					Risk Category				
	1	2	3	4	1-4	1	2	3	4	1-4
Policy Designs										
Single Premium										
$4,000/mo for moderate/severe disability	$76,509	$76,965	$72,208	$73,155	$75,016	$104,830	$93,052	$112,231	$112,218	$106,056
Difference from risk category 1	0.00%	0.60%	-5.62%	-4.38%	-1.95%	0.00%	-11.24%	7.06%	7.05%	1.17%
Above plus $2,000/mo for severe disability	$91,708	$92,498	$85,156	$88,072	$89,676	$130,184	$115,878	$137,912	$139,180	$131,479
Difference from risk category 1	0.00%	0.86%	-7.14%	-3.96%	-2.22%	0.00%	-10.99%	5.94%	6.91%	0.99%
Monthly Premium with No Lapses										
$4,000/mo for moderate/severe disability	$677	$781	$722	$980	$743	$868	$979	$1,076	$1,318	$973
Difference from risk category 1	0.00%	15.37%	6.68%	44.73%	9.71%	0.00%	12.80%	23.94%	51.84%	12.07%
Above plus $2,000/mo for severe disability	$811	$939	$852	$1,179	$888	$1,078	$1,219	$1,322	$1,635	$1,206
Difference from risk category 1	0.00%	15.68%	4.95%	45.37%	9.43%	0.00%	13.11%	22.64%	51.64%	11.86%
Monthly Premium with Lapses										
$4,000/mo for moderate/severe disability	$605	$729	$609	$900	$661	$662	$817	$934	$1,187	$791
Difference from risk category 1	0.00%	20.53%	0.70%	48.78%	9.32%	0.00%	23.36%	41.00%	79.23%	19.45%
Difference from no lapse premium	-10.64%	-6.65%	-15.65%	-8.14%	-10.95%	-23.72%	-16.58%	-13.22%	-9.96%	-18.70%
Above plus $2,000/mo for severe disability	$727	$879	$719	$1,086	$793	$824	$1,019	$1,148	$1,477	$963
Difference from risk category 1	0.00%	20.92%	-1.09%	49.37%	9.03%	0.00%	23.70%	39.29%	79.20%	16.88%
Difference from no lapse premium	-10.40%	-6.34%	-15.56%	-7.94%	-10.73%	-23.54%	-16.38%	-13.16%	-9.64%	-20.11%

Conclusions about LTCI

- Different risk groups have similar expected disability costs.
- Level premium structure of policies makes pooling difficult
  - People in poor health pay premiums for fewer years.
- Lapses exacerbate differences in risk pools.
- Lapses also make policies look cheaper.

Would life care annuity pool risks better?

- Combine disability indemnity policy with $1,000/month immediate life annuity.
- How would such a policy compare to the expected value of separately purchased policies?
  - Not just the actuarial value of separately purchased policies, but also factoring in the apparent discount of policies that allow lapses.

Comparison of life care annuity with separately purchased policies

	Male				Female			
	Risk Category				Risk Category			
	1	2	3	4	1	2	3	4
No inflation protection on annuity	LCA Premium=$213,964				LCA Premium=$264,478			
Actuarial Value	$221,835	$216,683	$206,571	$196,655	$268,845	$242,605	$265,886	$256,383
% departure from LCA cost	3.68%	1.27%	-3.46%	-8.09%	1.65%	-8.27%	0.53%	-3.06%
PDV of annuity premium								
+ LTCI premium w/lapse	$212,294	$216,755	$202,031	$211,209	$238,197	$235,555	$258,428	$255,882
% departure from LCA cost	-0.78%	1.30%	-5.58%	-1.29%	-9.94%	-10.94%	-2.29%	-3.25%
With inflation protection on annuity	LCA Premium=$244,092				LCA Premium=$301,435			
Actuarial Value	$255,745	$247,008	$234,530	$216,939	$310,025	$276,024	$298,234	$281,854
% departure from LCA cost	4.77%	1.19%	-3.92%	-11.12%	2.85%	-8.43%	-1.06%	-6.50%
PDV of annuity premium								
+ LTCI premium w/lapse	$246,204	$250,666	$235,941	$245,120	$279,377	$276,735	$299,607	$305,597
% departure from LCA cost	0.87%	2.69%	-3.34%	0.42%	-7.32%	-8.19%	-0.61%	1.38%

Life Care Annuity=$1,000/month annuity with 10-year minimum payments and $4,000/month for moderate disability with $2,000/month additionally for severe disability

Further Discussion: Alternative Solutions?

- Underwriting Life Annuities
  - Rare in U.S., but done in U.K.
  - Difficult and Expensive
- Purchases at Younger Ages
  - Long Periods Without Liquidity
  - Increased Issuer Solvency Risk
- Single-Premium LTCI
  - Little Underwriting Needed and No Lapses
  - Issuer Uncertainy About Claims?
  - Periodic Premium Policies Dominate Because of Consumer Myopia
  - Periodic Premiums Lower by 10 percent for Men and 24 percent for Women
- CLASS Program (see Warshawsky (2009))