Risky Insurance: Life-cycle Insurance Portfolio Choice with Incomplete Markets

Joseph Briggs (Goldman Sachs), Ciaran Rogers (HEC), and Christopher Tonetti (Stanford GSB)

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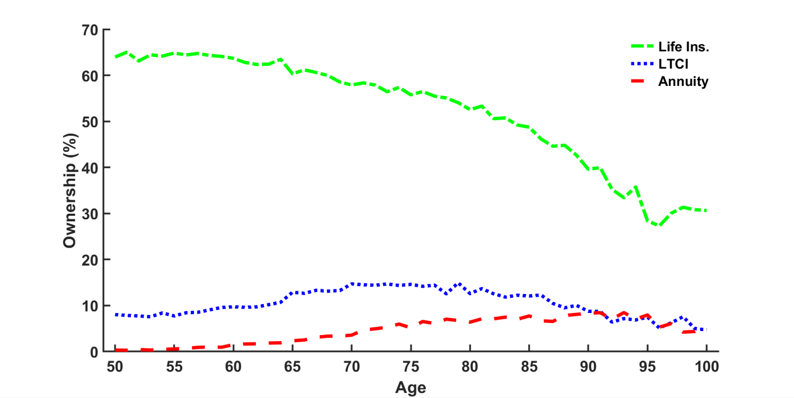
Note: New Paper Draft Coming Soon

Background

- Despite significant risks and spending needs late in life, most people choose not to purchase insurance
  - Private annuities and long-term care insurance (LTCI) are typically owned by less than 10 percent of older Americans



Background: Economic Forces that Influence Insurance Demand

Reasons to expect purchase of private insurance and reasons to expect no purchase. Function of preferences, states, risks, and broader environment.

- Motives: Uncertain death timing, Bequests, Long-term-care risks
- Environment (in U.S.): Medicaid and Social Security + complicated private sector
  - Medicaid covers LTC, means testing limits demand for LTCI for lower-wealth individuals
  - Most Americans already annuitized via Social Security
  - Insurance market with high loads, complicated contract structures, and quantity restrictions

Background: Literature

Understanding life-cycle insurance demand has been the subject of a large body of research:

- **Annuities**: Yaari (1965); Brown (2001); Davidoff, Brown, Diamond (2005); Inkmann, Lopes, Michaelides (2011); Peijnenburg, Nijman, Werker (2016); etc.
- **Life Insurance**: Bernheim (1991); Chambers, Schlagenhauf, Young (2004); Inkmann, Michaelides (2012); Hong Rios-Rull (2012); etc.
- **LTCI**: Brown, Finkelstein (2008); Lockwood (2012); Ameriks, Briggs, Caplin, Shapiro, Tonetti (2018); Mommaerts (2016); etc.
- **Insurance Portfolio**: Hubener, Maurer, and Rogalla (2013); Koijen, Van Nieuwerburgh, Yogo (2016), Michaud and St. Amour (2023)

Many "puzzles." Generally find that consumer insurance holdings are suboptimal and suboptimal holdings impose large welfare costs

Existing Research Approaches

Typically, studies that use structural models take one of two approaches:

1. Very Incomplete Markets with Stylized Products: E.g., introduce a one-time option to purchase a single insurance product and compare demand to actual insurance holdings
2. Complete Markets: Assume markets are complete and calculate life-cycle profiles of demand for portfolio of state contingent assets (Koijen, Van Nieuwerburgh, Yogo (2016))

Our approach:

- Portfolio choice of multiple insurance products
- Model key features of insurance products to make them better match real-world products

One Feature of Real-World Insurance: Nonpayment Risk

"There is really no mystery about [why people don't buy] long term health insurance. The reason it seems to defy reason is because your assumptions are flawed. .... My father had emphysema and **the insurance company fought tooth and nail to prevent paying for years. ... And of course, only paying 50 to 80% of what they owed him.** *Not that they were stupid, but that they were greedy.* **If we believed they would pay what they should when they should, we'd buy.** *It's not what the odds are on that lottery ticket, it is what are the odds you'll get paid if you win."*

– Email from Stanford GSB alumnus who read a previous paper of mine

- One key dimension of real-world products may be nonpayment risk
- We measure and model (perceived) nonpayment risk. No measure from administrative data, so design a survey
- In model will simulate 2 ways: rational expectations or zero nonpayment risk in DGP

Risky Insurance: Nonpayment Risk Interpretations

- Difficult state verification of qualifying event
  - LTCI: LTC need difficult to verify
  - Annuity/Life Insurance: death easy to verify
- Financial health of insurer
  - Lack of trust or knowledge of government insurance of insurers
  - When used, government insurance may lead to haircuts???
- Hassle/Paperwork thicket
  - Interacts with cognitive ability
  - LTCI: reimbursement model for qualifying expenses
  - Real-time paperwork risk, but also historical paperwork risk (e.g., omitted smoking history)

Question and Research Design

How do properties of the available insurance products affect the demand for insurance and the welfare gains from buying insurance against late-in-life risks?

- We study portfolio choice of annuities, life insurance, LTCI, and bonds

Approach:

- New data:
  - Measured beliefs about nonpayment risk
- New model:
  - Life-cycle model of joint demand for insurance with exogenously incomplete markets
  - We model products as they are in the market and as they are perceived by consumers
  - Buy/Sell price wedges, nonpayment risk, quantity limits (age, no short-selling)

Key Results

1. Perceived nonpayment risk is large in annuity, life insurance, and LTCI markets
2. Perceived nonpayment risk is predictive of actual insurance holdings
3. Nonpayment risk and non-actuarially fair pricing have large affect on insurance ownership
4. After accounting for nonpayment risk and incomplete market features, welfare costs associated with deviations from optimal insurance portfolios (autarky) are much smaller

- **If real-world products aren't that good, not surprising that people don't buy them and welfare costs of not buying them are small**

Survey Overview

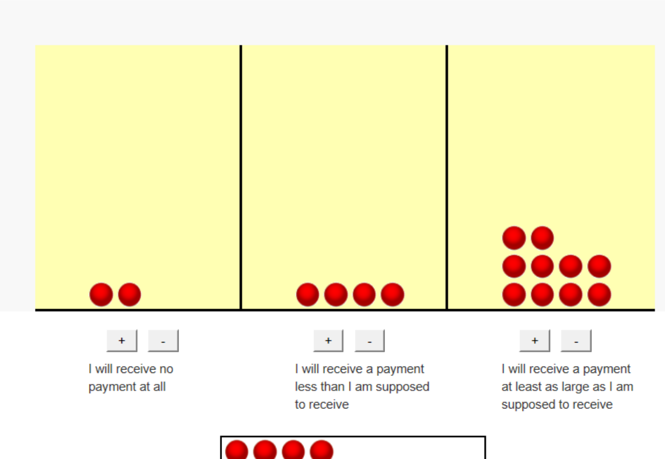
- Understanding America Study (UAS) representative sample of US pop age 45+ ($N = 1040$)
- Insurance product ownership
- Nonpayment risk measures
  - Adapted from Luttmer-Samwick (2018)
  - Probability of contract termination
  - Distribution of annual payment conditional on qualifying event
  - Repeat for different aggregate economic state (skipping today)
- Certainty equivalent measure (skipping today)
- Other supplementary measures (skipping today)

Measuring Nonpayment Risk - Annual Payout Default (1/2)

Suppose that you own an annuity that promises to pay $24,000 each year for the rest of your life. We would now like to focus on what might happen just during the next calendar year.

You have been given 20 balls to put in the following bins. Each bin describes a scenario that involves the annuity payment that you are supposed to receive next year. The more likely you think a bin is, the more balls you should put in that bin.

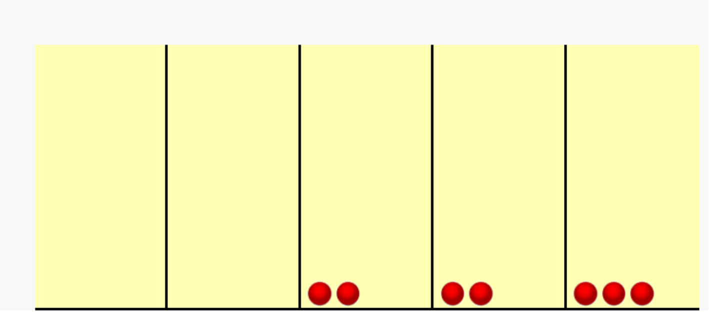
What do you think will happen to the annuity payment next year?



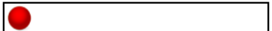
Measuring Nonpayment Risk - Annual Payout Default (2/2)

You put 8 ball(s) in the bin marked "I will receive a payment less than I am supposed to receive." Please distribute those balls in the following bins. The more likely you think a bin is, the more balls you should put in that bin.

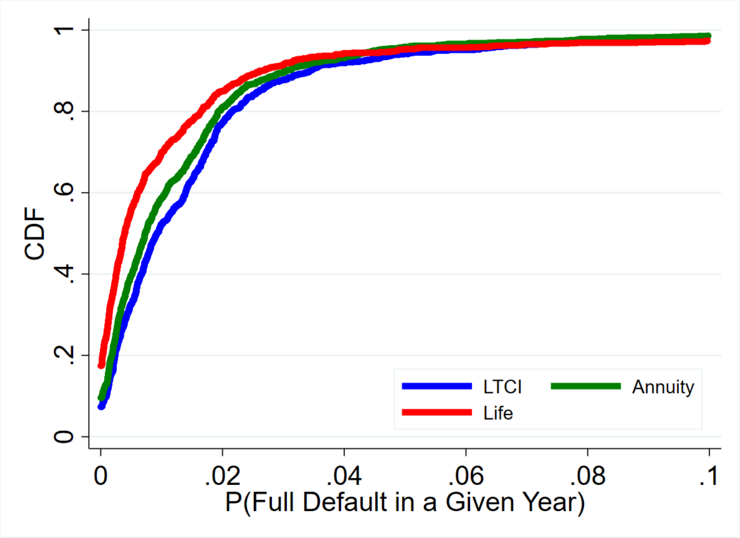
If you do receive a payment that is less than you are supposed to receive, how much do you think you would get?



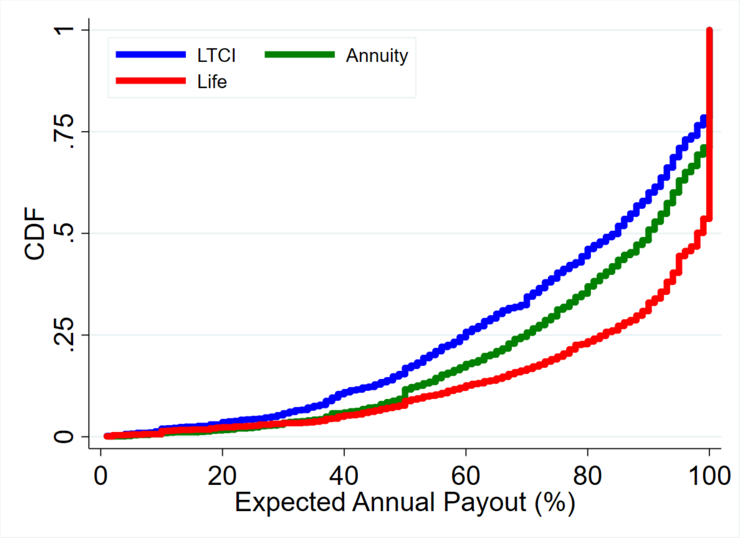
+ -	+ -	+ -	+ -	+ -
I will receive between 1%-19% of the payment I am supposed to receive	I will receive between 20%-39% of the payment I am supposed to receive	I will receive between 40%-59% of the payment I am supposed to receive	I will receive between 60%-79% of the payment I am supposed to receive	I will receive between 80%-99% of the payment I am supposed to receive



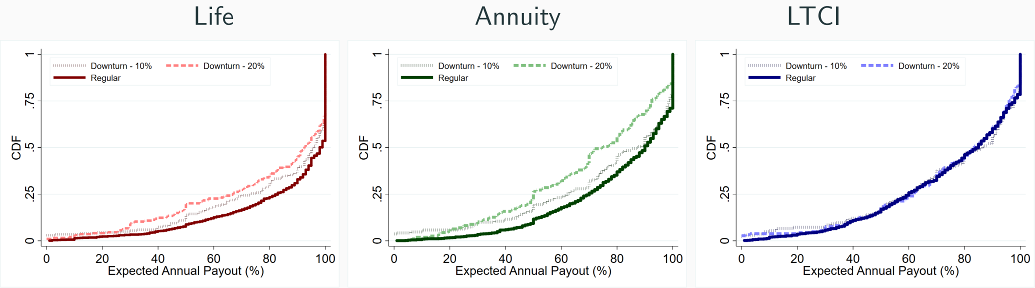
Distribution of Full Default Probability



Distribution of Expected Value of Annual Payments



Annuity and Life Expected Payouts Vary with Stock Market Drop, but LTCI Payouts Do Not



What Individual Characteristics Predict Subjective Nonpayment Risk

- We regress subjective nonpayment beliefs on individual characteristics
- Higher cognitive and financial literacy scores and higher propensity to plan perceive lower risk
- Having experienced fraud in the past is associated with higher perceived risk
- Qualitative responses on main considerations when considering risk (personal and family/friends experiences with insurers, complexity of contracts, trust in insurers are commonly cited)
- Checks in paper on consistency and quality of responses

Nonpayment Risk Measures Predict Insurance Ownership

Probit Regression: $OwnInsurance_i = \beta_1 PaymentBeliefs_i + \beta_2 X_i + \epsilon_i$

	Own Annuity (1)	Own Life (2)	Own LTCI (3)	Own Annuity (4)	Own LIfe (5)	Own LTCI (6)
Annuity Payment Exp. Value	-0.0018 (0.212)			-0.0005 (0.373)		
Annuity Full Def. Prob	-0.0021*** (0.000)			-0.0020*** (0.000)		
Annuity Payment SD	-0.0043** (0.002)			-0.0029*** (0.000)		
Life Payment Exp. Value		0.0046*** (0.001)			0.0045** (0.003)	
Life Full Default Prob		-0.0015 (0.129)			-0.0013 (0.142)	
Life Payment SD		-0.0006 (0.686)			-0.0002 (0.896)	
LTCI Payment Exp. Value			0.0007 (0.111)			0.0006 (0.181)
LTCI Full Default Prob			-0.0023*** (0.000)			-0.0022*** (0.000)
LTCI Payment SD			-0.0009 (0.195)			-0.0010 (0.136)
Trust				0.0188 (0.091)	-0.0063 (0.758)	0.0162 (0.241)
Cognitive Score				-0.0007 (0.747)	-0.0033 (0.271)	0.0004 (0.852)
Financial Literacy Score				-0.0112 (0.459)	-0.0662* (0.019)	-0.0083 (0.609)
Numeracy Score				-0.0079 (0.560)	0.0207 (0.319)	-0.0240 (0.101)
Experienced Fraud				0.0298 (0.549)	0.0545 (0.375)	-0.0031 (0.941)
Risk Aversion				-0.0072 (0.252)	-0.0160 (0.072)	-0.0015 (0.776)
Propensity to Plan				0.0137 (0.243)	-0.0013 (0.947)	0.0016 (0.888)
Early Stock Returns				0.1474 (0.757)	-0.5123 (0.441)	-0.7936 (0.122)
N	1055	1046	1040	1055	1046	1040
R^2	0.170	0.132	0.129	0.268	0.218	0.179
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes

p-values in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Extrapolation of Regression Suggests Nonpayment Risk Limits Market Size

Counterfactual Predictions of Probit Regressions with Zero Loading on Nonpayment Risks

	P(Own)	P(Own—No Risk)
Annuity	.12	.24
Life	.57	.66
LTCI	.10	.23

Structural Model Overview 1/2

- Life-cycle, heterogeneous agent choice problem
- Each year age 45+ individuals choose how much to consume, save, and a portfolio allocation of savings to a risk free bond (≥ 0) and 3 insurance products
- Individuals exogenously heterogeneous in age, income age-profile (including SS and DB pensions), sex, and health status
- Health states: Healthy, Sick, Need LTC, Dead
  - Stochastic health Markov process (age and sex dependent)
  - Health cost shocks (age, sex, and health-state dependent)
- Nonhomothetic health-state dependent utility (as in ABCST JPE 2020)
- Individuals endogenously heterogeneous in wealth, insurance holdings, insurance premia, government care status (means-tested welfare or Medicaid)

Structural Model Overview 2/2

- Insurance Costs: Annuity lump sum payment; LI and LTCI yearly premia
- Exogenous insurance prices reflect empirical markups above actuarially fair value
- No short sales of insurance
- Nonpayment Risk
  - Some probability purchased insurance terminates
  - Conditional on qualifying event and having insurance, insurance pays out some random fraction of promised payouts
  - Probabilities from survey (representative subjective beliefs)

Preferences

- Households have time-separable, health-state dependent non-homothetic preferences defined over a consumption good C_t and a warm-glow bequest motive. Flow utility ν_s is:

$$\nu_s(C_t) = \frac{\theta_{s,t}^{-\sigma}(C_t + \kappa_s)^{1-\sigma}}{1-\sigma}$$

- Specification from Ameriks et. al. (JPE 2020)
- Key functional-form innovation is nonhomotheticity ($\kappa_{LTC} \neq 0$) in LTC health state
- But with age-varying $\theta_{s,t}$ (helps match life insurance holdings)
  - $\theta_{beq,t} = \theta_{beq}^{young} + \left(\frac{exp(nx)-1}{exp(x)-1}\right)(\theta_{beq} - \theta_{beq}^{young})$; $x = \frac{(t-45)}{(80-45)}$
- With state-dependent utility, insurance demand is nuanced (e.g., risk-averse agent might not buy actuarially fair insurance)

Insurance Products: Pricing and Dividends

- Base price for 1 unit of insurance $p^k_{t_0,s_0,f}$
- Base price is actuarial fair price from risk neutral insurance company. Function of:
  - $\bar{D}^k$ payout vector defines qualifying event states
  - r^{ins} interest rate of insurers
  - $\Gamma_{t,f}$ stochastic process for health state
- Modifiers on Base Price to obtain Market Price to buy and sell: λ^k_+, λ^k_- (next slide)
- Annuity purchased with lump-sum wealth; LI, LTCI paid for with annual premium
  - Annual premium $\Upsilon^k_{t_0,s_0,f}$:= market price/expected years of life
  - Annual premium is a state variable, locked in at purchase date
- No new purchases after age $t^{max,k}$: $W^k_t \leq 0 \; if \;\; t > t^{max,k}$

Insurance Products: Transactions

- W_t^k denotes net transactions in insurance product k
- $\lambda_+^k(\lambda_-^k)$ is the % transaction cost to buying (selling) product k
- Lump-sum cost of transaction (ANN):

$$W_t^{ann} p_{t,s,f,G}^k \left(1 - \lambda_-^{ann} \mathbb{I}_{W_t^{ann}<0} + \lambda_+^{ann} \mathbb{I}_{W_t^{ann}>0}\right)$$

- Yearly premium (LI, LTCI): Any adjustment resets premium to new value
  - new annual premium is a function of states at time of adjustment
  - as if didn't previously own and buying for first time
  - keeps state space tractable
- No new purchases after age $t^{max,k}$: $W_t^k \leq 0 \; if \;\; t > t^{max,k}$

Quantifying the Model

1. Standard external calibration of income, health process and costs
2. External calibration of insurance product features
   - Feed in measured values, as opposed to estimation in order match insurance ownership
3. SMM estimation of preference parameters and interest rates to match moments on
   - wealth distribution by age
   - average insurance holdings
   - stated preferences SSQs

Insurance Products Calibration

	Annuities	Life	LTCI
Full default prob	.014	.013	.018
Expected annual payout	.80	.87	.76
Load when buying	.2	.25	.32
Discount when selling	.15	–	–
Max Purchase age	80	80	80

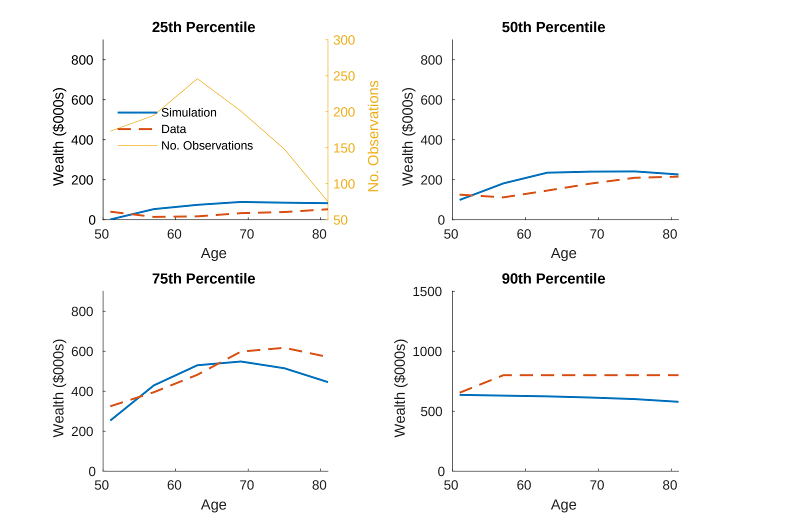
- Default and nonpayment probabilities: Original survey
- Annuity and LTCI Loads: Brown and Finkelstein (JEP 2011)
- Life insurance loads: Hong and Rios-Rull (AER 2012)
- Annuity discount and max purchase age: Industry reports (to be improved)

SMM Calibration - Preferences and Interest Rates

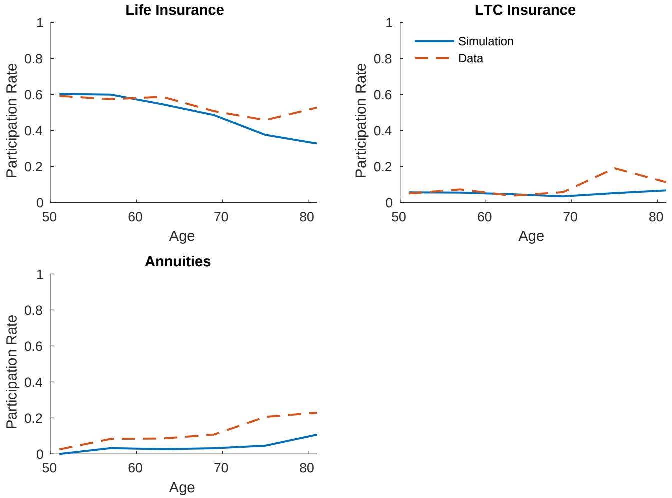
Time Preference - $\beta = 0.96$	**Risk Aversion** - $\sigma = 2.5$
Bequest motive - $\theta_{beq} = 1.09$	**Bequest motive** - $\kappa_{beq} = 5$
Young bequest motive - $\theta_{beq}^{young} = 0.12$	
LTC motive - $\theta_2 = 0.67$	**LTC motive** - $\kappa_2 = -30$
Insurer interest rate - $R_{ins} = 1.025$	**Bond interest rate** - $R = 1.04$

- Model takes about 18 hours to solve for a given set of parameter values
- Start around JPE paper values and manually explore parameter space
- Main difference from JPE paper is lower risk aversion

Wealth: Model and Data



Insurance Ownership: Model and Data



Model Predictions with Rational Expectations

	Data	No Insurance	Baseline	No Price Wedges	No Nonpayment Risk	No Price Wedges or Nonpayment Risk
A. *Insurance Ownership*						
LI	54.2%	0.0%	54.8%	72.1%	71.7%	85.1%
LTC	8.0%	0.0%	9.3%	32.9%	44.4%	52.4%
Ann	10.5%	0.0%	5.6%	5.8%	8.5%	15.4%
B. *Welfare Gains*						
Consumption Equivalent	-	-	1.6%	2.5%	4.0%	5.7%

- Real-world asset features have strong effect on ownership
- Welfare costs of "under-insurance" much smaller than complete market analysis suggests

Alt Baseline: Empirical Nonpayment Beliefs, but Payments Always Made

	Data	No Insurance	Baseline	No Price Wedges	No Nonpayment Risk	No Price Wedges or Nonpayment Risk
A. *Insurance Ownership*						
LI	54.2%	0.0%	56.9%	74.2%	71.7%	85.1%
LTC	8.0%	0.0%	10.0%	34.3%	44.4%	52.4%
Ann	10.5%	0.0%	5.8%	6.1%	8.5%	15.4%
B. *Welfare Gains*						
Consumption Equivalent	-	-	3.0%	4.4%	4.0%	5.7%

- Hold fixed empirical payment beliefs, change payouts in simulation
- Welfare Gains: Rational Expectations vs. Payments Always Made
  - Constant beliefs, vary payments: 3.0% vs. 1.6% — obviously payouts are better than not
- Always pay, vary beliefs: 3.0% vs. 4.0%
  - Even when payments are always made, 3.0% welfare gain in baseline compared to 4.0% if beliefs correctly reflected zero non-payment risk
  - Reflects large differences in ownership driven by beliefs

Remove Nonpayment Risk One Product at a Time (Rational Expectations)

	Welfare Gain
LI	0.35%
Ann	0.1%
LTCI	0.3%

- Welfare gain from all 3 product, but primarily LI and LTCI
- Insurance products are compliments, as sum of each change is less than welfare effect of joint change (0.75% vs. 1.6%)

Further Analysis (Preliminary)

- Welfare gains by wealth distribution
  - Declining in wealth
- Changes in profits earned by insurers
- Portfolio changes and welfare gains if no Social Security (rebating SS payments to young)
  - Decline in insurance purchases and increased self-insurance in bonds
- Portfolio changes and welfare gains if decline in Medicaid LTC provision
  - Large declines in welfare and increases in LTCI ownership

Conclusion

- Perceived nonpayment risk is large in annuity, life insurance, and LTCI markets
- Incomplete markets and perceived risks are important determinants of insurance holdings
- Measuring and modeling actual product features is important when studying consumer choices and welfare
- Welfare costs associated with deviations from optimal insurance portfolios crucially depend on features of products and consumer beliefs