

Old, frail and uninsured: Accounting for features of the U.S. long-term care insurance market

R. Anton Braun

Federal Reserve Bank of Atlanta

Karen A. Kopeccky

Federal Reserve Bank of Atlanta

Tatyana Koreshkova

Concordia University and CIREQ

Minnesota Graduate Class

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*These are our personal views and not those of the Federal Reserve System.

Nursing Home (NH) Risk

- NH expense risk in the U.S. is significant:
 - Lifetime probability of a long-term NH stay (over 100 days) is 30%, average duration \approx 3 years, and annual cost \approx \$85,000.
 - 10.6% of individuals will incur OOP LTC expenses $>$ \$200,000. (HHS)
- Yet, private long-term care insurance (LTCI) market is small:
 - About 10% of 62+ have private LTCI.
 - LTCI takeup rates range from $<2\%$ to 20% by wealth quintile.

Additional features of the LTCI market

- 1 Denials are common:
 - Industry surveys find that 20% of applications are withdrawn or denied by underwriters.
 - We estimate that 36–56% of 55–66 year olds would be denied due to health if they applied for LTCI. [details](#)
- 2 Coverage is incomplete:
 - Provides indemnity, not a service benefit.
 - Coverage is 34–66% of expected losses.
- 3 Highly concentrated: 66% of new policies in 2013 were written by three largest insurance companies.
- 4 Loads $(1 - \frac{E \text{ benefits}}{E \text{ premia}})$ are high relative to other insurance lines:
 - Longterm care insurance: 0.18 to 0.51.
 - Life annuity insurance: 0.15 to 0.25.
 - Group health insurance: 0.04 to 0.15.
- 5 Profits are low. Industry has experienced lots of exit.

What accounts for low LTCI takeup rates?

We explore the role of 3 features of this market:

- Individuals have private information about their NH entry risk.
 - And they act on it: high risk types are more likely to buy LTCI (Finkelstein and McGarry, 2006) [details](#)
 - As a result, insurers are exposed to adverse selection.
- Insurers' administrative costs are significant.
 - Fees paid to insurance brokers exceed 100% of first year's premium.
 - Underwriting and claims processing expenses average 20% of present-value premium.
- Public insurance is available through Medicaid.
 - Medicaid is means-tested and a secondary payer.
 - Brown and Finkelstein (2008) find that it has a large crowding out effect on demand for private NH insurance.

Approach

- Develop an optimal contracting model with private information, administrative costs, and Medicaid.
- **Underwriting works as in practice:**
LTC insurer assigns individuals to risk groups based on observable health status and finances then decides:
 - ① which risk groups to insure and which to deny (risk group selection).
 - ② pricing and coverage of insured risk groups.
- Show:
 - Model can account simultaneously for low LTCI takeup rates and many other features of LTCI market.
 - Risk group selection (activated by combining private information with admin. costs or Medicaid) plays crucial role.
 - All three frictions are needed to account for pattern of LTCI ownership in the data.

Related Lit

Overview of rest of the talk

- ① Simple Model
- ② Quantitative model
- ③ Parameterization
- ④ Results

Simple Model Motivation

Use a simple adverse selection model to show that when administrative costs on the insurer and/or Medicaid are present:

- 1 Low LTCI take-up rates can arise in two different ways:
 - **Risk-group selection:** All individuals in some risk groups are denied coverage.
 - **Choice:** Good-risk types self-select into a no-coverage contract and bad-risk types choose a positive-coverage contract.
- 2 The optimal menu can feature partial coverage contracts for all individuals in the risk group.

Simple Model

- Consider first a single risk group.
- Continuum of individuals.
- Individuals have private type $i \in \{g, b\}$ and risk exposure (NH entry probability) θ^i with $0 < \theta^g \leq \theta^b < 1$.
- Fraction of good risk individuals is ψ .
- Timing:
 - Agents receive endowment w_0 and then purchase LTCI with premium π^i and indemnity ι^i .
 - Then the NH event is realized and $\eta \equiv \psi\theta^g + (1 - \psi)\theta^b$ individuals enter a NH and incur expenses m .

Individual's Problem

An individual of type i solves

$$\max_{c_{NH}^i, c_o^i, \pi^i, \iota^i} \theta^i u(c_{NH}^i) + (1 - \theta^i) u(c_o^i)$$

where

$$c_o^i = w_o - \pi^i,$$

$$c_{NH}^i = w_o + TR(w_o, \pi, \iota, m) - \pi^i - m + \iota^i,$$

$$TR(w_o, \pi, \iota, m) = \max \left\{ 0, \underline{c}_{NH} - [w_o - \pi - m + \iota] \right\}.$$

- Medicaid is a means-tested and a secondary payer (higher ι means lower Medicaid benefits).

Firm's Problem

Single monopolist insurer who faces

- variable cost of paying claims with constant of proportion $\lambda - 1 \geq 0$ and,
- fixed cost $k \geq 0$ of paying claims,

solves

$$\max_{\{\pi^i, \iota^i\}_{i \in \{g, b\}}} \psi \left\{ \pi^g - \theta^g [\lambda \iota^g + k I(\iota^g > 0)] \right\} \\ + (1 - \psi) \left\{ \pi^b - \theta^b [\lambda \iota^b + k I(\iota^b > 0)] \right\}$$

subject to

$$(PC_i) \quad U(\theta^i, \pi^i, \iota^i) - U(\theta^i, 0, 0) \geq 0, \quad i \in \{g, b\},$$

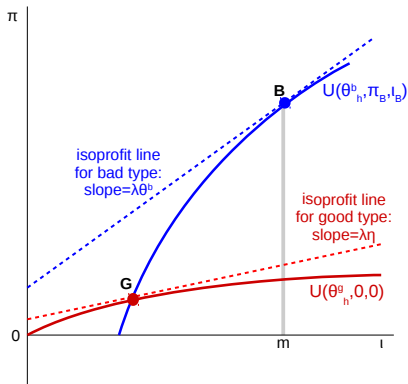
$$(IC_i) \quad U(\theta^i, \pi^i, \iota^i) - U(\theta^i, \pi^j, \iota^j) \geq 0, \quad i, j \in \{g, b\}, i \neq j,$$

where $U(\theta^i, \pi^i, \iota^i) \equiv \theta^i u(c_{NH}^i) + (1 - \theta^i) u(c_o^i)$.

Classic Properties of the Model: Standard Setup

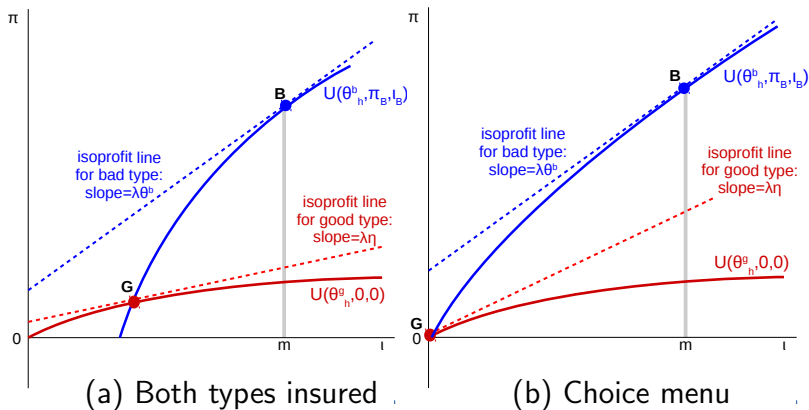
If $\lambda = 1$, $k = 0$, and $\underline{c} = 0$ the model generates the *classic* findings (Stiglitz, 1977 or Chade and Schlee, 2012):

- 1 *Separating equilibria.*
- 2 *Full insurance at the top.*
- 3 *Downward distortion for good risks.*



Generating low take-up rates: Standard Setup

- In (a) LTCI take-up rate is 100%.
- Partial take-up due to choice, menu (b), can arise if
 - fraction of good types (ψ) is sufficiently low or,
 - NH entry dispersion (θ^b/θ^g) is sufficiently high.

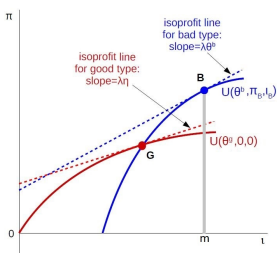


Proportional administrative costs

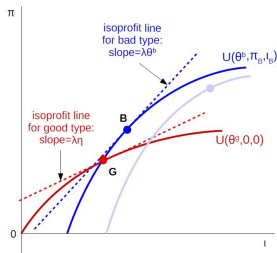
With proportional administrative costs, $\lambda > 1$, the model can generate:

- *Pooling*. Good and bad types offered same contract.
- *No trade due to risk group selection*. Optimal contract is pooling at $(0, 0)$.
- *Incomplete insurance even at the top*.

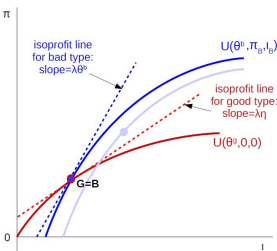
Intuition: Increasing λ



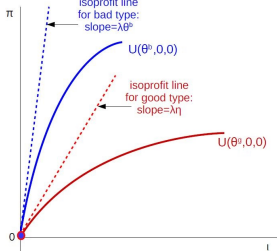
(a) $\lambda = 1$



(b) Separating eqm $\lambda > 1$



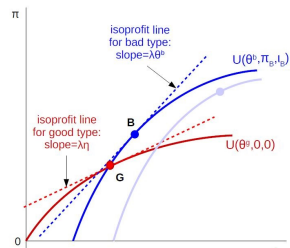
(c) Pooling eqm $\lambda > 1$



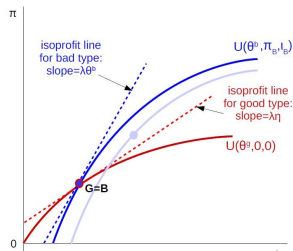
(d) No trade eqm $\lambda > 1$

Equilibria w/ proportional admin. costs

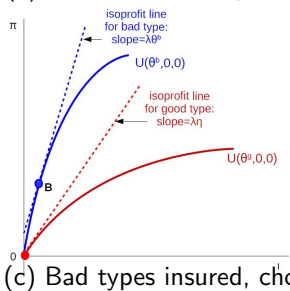
With proportional admin. cost, $\lambda > 1$, the following menus can occur:



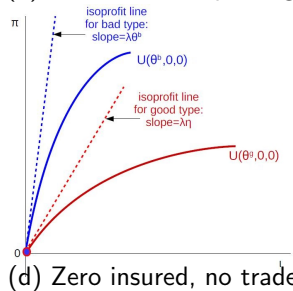
(a) 100% insured, separating



(b) 100% insured, pooling



(c) Bad types insured, choice



(d) Zero insured, no trade

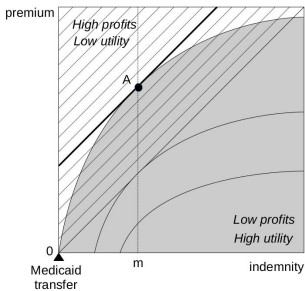
Fixed administrative costs

- Fixed administrative costs, $k > 0$, reduce the insurer's profits and can also generate no-trade.

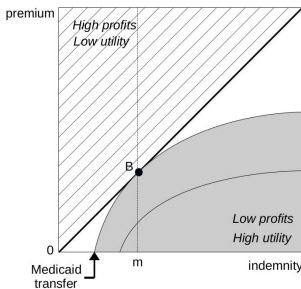
With Medicaid, $\underline{c}_{NH} > 0$, the model can also generate:

- *Low LTCI take-up rates by either choice or no trade.*
- *Incomplete insurance even at the top.* Under certain conditions.

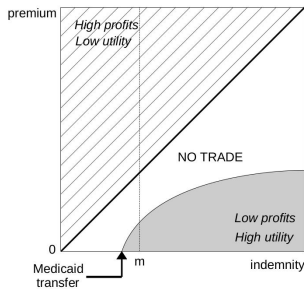
Intuition: Increasing Medicaid Cons. Floor \underline{c}_{NH}



(a) $\underline{c}_{NH} = 0$



(b) Low \underline{c}_{NH}



(c) High \underline{c}_{NH}

- When $\underline{c}_{NH} > w_0 - \pi - m + \iota$, marginal increases in ι are offset by reductions in Medicaid transfers.
- In (b), because the agent's outside option has improved, insurer must reduce premium to satisfy PC.
- In (c), there is no profitable contract that is attractive to the agent.

Intuition: Increasing Medicaid cons. floor \underline{c}_{NH}

- Thus Medicaid can generate denials of poorer individuals for which \underline{c}_{NH} is large relative to w_o .
- When w_o is uncertain, Medicaid generates partial coverage contracts.
 - Suppose individual is eligible for Medicaid under some realization of w_o but not others.
 - He is partially insured against NH risk in expectation \Rightarrow prefers partial private LTCI coverage.

The Quantitative Model: Multiple risk groups

When there are multiple risk groups, low LTCI take-up rates can occur due to a combination of both choice and no-trade menus.

Specifically we assume:

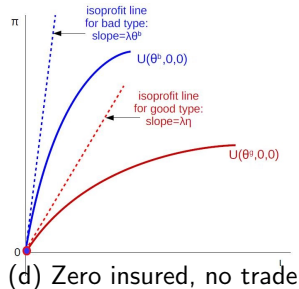
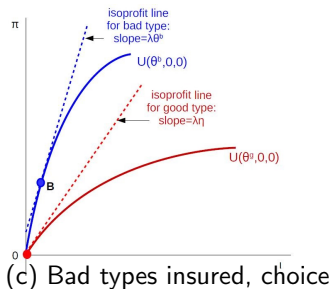
- Agents vary by
 - Endowments \mathbf{w} ,
 - Frailty f ,

in addition to private type i .

- The insurer observes these noisy indicators, (f, \mathbf{w}) , of an individual's true NH risk exposure: $\theta_{f,\mathbf{w}}^i$ and sorts agents into risk groups.
- The extent of private information, $\{\theta_{f,\mathbf{w}}^g, \theta_{f,\mathbf{w}}^b\}$, varies across the risk groups.

The Quantitative Model: Choice v. no-trade menus

- No-trade menus are more likely to arise when dispersion in private information, $(\theta_{f,w}^b/\theta_{f,w}^g)$, is high and $\theta_{f,w}^b$ is close to one. Why?
 - High $(\theta_{f,w}^b/\theta_{f,w}^g)$ makes cross-subsidizing menus unattractive.
 - High $\theta_{f,w}^b$ makes choice menus unattractive.



The Quantitative Model: Additional features

- Before contracting, agents make a consumption—savings decision.
 - Expectations about public and private insurance impact savings.
 - Savings impacts optimal contracts.
- After contracting, agents incur a consumption demand shock.
 - Captures, in a parsimonious way, uncertainty faced between LTCI purchase and NH entry.
 - Produces partial coverage contracts under Medicaid.
- Agents face survival risk between LTCI purchase and NH event.
 - Survival is correlated with frailty and wealth and impacts likelihood of NH entry.

The Model: Timing of events

- **Period 1:** Individuals observe their frailty status f , endowments w , and menu of contracts.
- Receive w_y , choose consumption (c_y) and savings (a).
- **Period 2:** Individuals draw type $i \in \{g, b\}$ with $\text{prob}(i = g) = \psi$.
- Receive w_o , and purchase private LTCI at a premium $\pi_{f,w}^i(a)$.
- Then experience a consumption demand shock $\kappa \in [\underline{\kappa}, \bar{\kappa}]$.
- With prob. $1 - s_{f,w}$ they get transfers, consume their wealth and die.
- **Period 3:** Survivors realize NH shock.
- NH entrants pay cost m , get indemnity $\iota_{f,w}^i(a)$ and Medicaid transfers, and consume.
- Non-entrants get welfare transfers and consume.

The Model: Individual's Problem

An individual of type $\{f, w\}$ solves

$$\begin{aligned} & \max_{a \geq 0, c_y, c_{NH}, c_o} u(c_y) + \beta \int_{\underline{\kappa}}^{\bar{\kappa}} u(\kappa w_y) q(\kappa) d\kappa \\ & + \beta \alpha \left\{ \psi \int_{\underline{\kappa}}^{\bar{\kappa}} [s_{f,w} \theta_{f,w}^g u(c_{NH}^{g,\kappa}) + (1 - s_{f,w} \theta_{f,w}^g) u(c_o^{g,\kappa})] q(\kappa) d\kappa \right. \\ & \left. + (1 - \psi) \int_{\underline{\kappa}}^{\bar{\kappa}} [s_{f,w} \theta_{f,w}^b u(c_{NH}^{b,\kappa}) + (1 - s_{f,w} \theta_{f,w}^b) u(c_o^{b,\kappa})] q(\kappa) d\kappa \right\} \end{aligned}$$

subject to

$$c_y = w_y - a,$$

$$c_o^{i,\kappa} + \kappa w_y = w_o + (1 + r)a - \pi^i(a), \quad i \in \{g, b\}$$

$$\begin{aligned} c_{NH}^{i,\kappa} + \kappa w_y &= w_o + (1 + r)d + TR(a, \pi, \iota, m, \kappa) \\ &\quad - \pi_{f,w}^i(a) - m + \iota^i(a), \quad i \in \{g, b\}. \end{aligned}$$

The Model: Government transfers

- The Medicaid transfer is means-tested:

$$TR(a, \pi, \iota, m, \kappa) = \max \left\{ 0, \underline{c}_{NH} - \left[w_o + (1+r)a - \pi - m + \iota - \kappa w_y \right] \right\}$$

- Medicaid is a secondary payer: higher ι means lower Medicaid benefits.
- The welfare consumption floor for non-NH entrants is \underline{c}_o .
 - If the agent prefers, we assume he saves nothing, does not purchase LTCI, and consumes at the consumption floors: \underline{c}_{NH} in the NH state and \underline{c}_o in the non-NH state.

The Model: Insurer's Problem

For each observable risk group $\{f, w\}$ insurer solves

$$\max_{\{\pi_{f,w}^i, \iota_{f,w}^i\}_{i \in \{g,b\}}} \psi \left\{ \pi_{f,w}^g - s_{f,w} \theta_{f,w}^g [\lambda \iota_{f,w}^g + k I(\iota_{f,w}^g > 0)] \right\} \\ + (1 - \psi) \left\{ \pi_{f,w}^b - s_{f,w} \theta_{f,w}^b [\lambda \iota_{f,w}^b + k I(\iota_{f,w}^b > 0)] \right\}$$

subject to

$$u_2(\theta_{f,w}^i, \pi^i, \iota^i) \geq u_2(\theta_{f,w}^i, \pi^j, \iota^j), \quad \forall i, j \in \{g, b\}, \quad i \neq j \quad (\text{IC}_i)$$

$$u_2(\theta_{f,w}^i, \pi^i, \iota^i) \geq u_2(\theta_{f,w}^i, 0, 0), \quad \forall i \in \{g, b\}, \quad (\text{PC}_i)$$

where

$$u_2(\theta_{f,w}^i, \pi^i, \iota^i) \equiv \int_{\underline{\kappa}}^{\overline{\kappa}} [s_{f,w} \theta_{f,w}^i u(c_{NH}^{i,\kappa}) + (1 - s_{f,w} \theta_{f,w}^i) u(c_o^{i,\kappa})] q(\kappa) d\kappa.$$

Parameterization of the Model: Overview

- We compute the model for 750 risk groups that vary by frailty, PE (and wealth).
- Some parameters are set directly using data and others are set by minimizing the distance between data moments and model counterparts.
- Many of our data moments are constructed using 1992–2012 HRS data.
- We construct a frailty index for HRS respondents that summarizes underwriting criteria used by LTC insurers.
- Lifetime NH entry probabilities for HRS respondents are estimated using an auxiliary simulation model.

details

Parameterization of the Model: Highlights

Three key frictions:

- the scale of the Medicaid program,
- the size of administrative costs,
- the extent of private information.

How do we parametrize these key components of the model?

Parametrization: The scale of Medicaid

- The Medicaid NH consumption floor \underline{c}_{NH} is set to the value of consumption transfers to Medicaid NH residents: \$6,540 a year in 2000 \times the average duration of a long-term NH stay: 2.98 years. [details](#)
- This is the same value as used by Brown and Finkelstein (2008).
- Consumption demand shock distribution chosen to match the wealth distribution at NH entry. [details](#)

Parametrization: The size of administrative costs

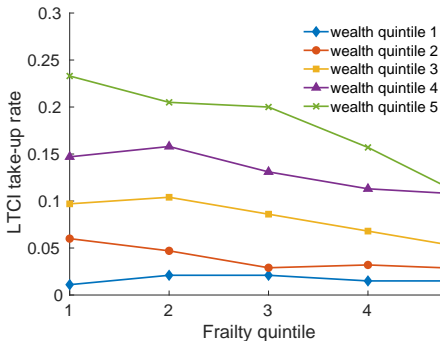
- We attribute underwriting costs and costs of paying claims to fixed costs.
- These costs are 20% of premia. The fixed cost parameter, k , is set match this target.
- We attributed commissions paid to agents and brokers to variable costs.
- These costs of 12.6% of premia. The variable cost parameter, λ , is set match this target.
- Data source: Society of Actuaries. (Based on year 2000 costs.)

Parametrization: The extent of private information

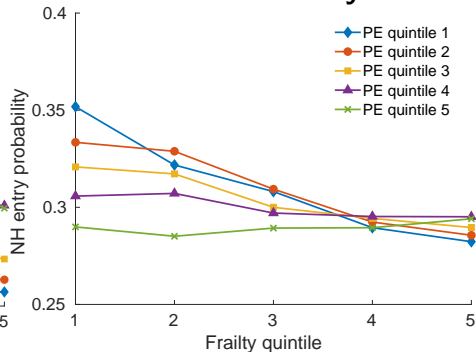
- The fraction of good types, ψ , is set such that the overall dispersion of private information in the model reproduces the dispersion of self-reported NH entry probabilities in our HRS data.
- $\{\theta_{f,w}^g, \theta_{f,w}^b\}$ by (f, w) target LTCI take-up rates and NH entry rates by frailty and wealth/PE quintiles.

Pattern of LTCI take-up and NH entry in the data

LTCI take-up rates



Lifetime NH entry rates

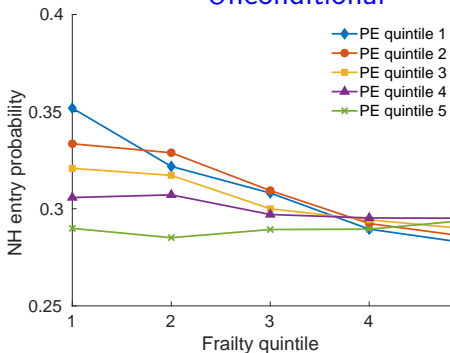


- LTCI take-up rates decline with frailty and increase with wealth.
- Lifetime NH entry risk slightly decreases with frailty and varies little with PE!

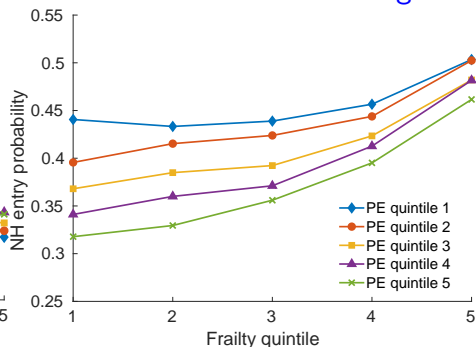
NH entry: unconditional v. conditional

Lifetime NH entry rates by frailty and PE quintiles

Unconditional



Conditional on Surviving



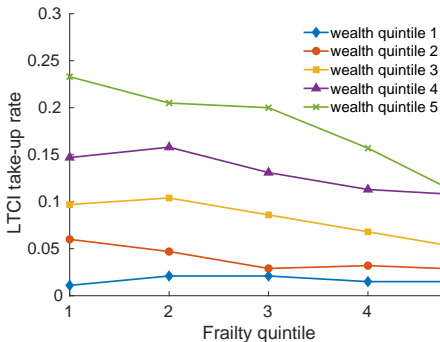
Why do NH entry patterns look this way?

- **Offsetting effect:** Probability of dying increases with frailty and decreases with PE.

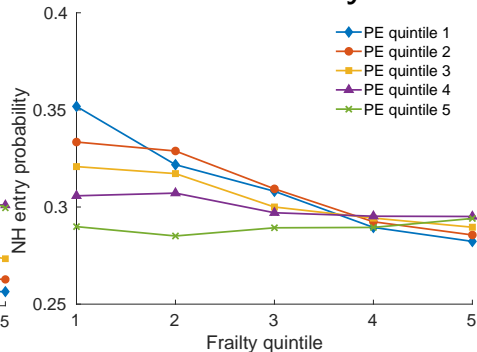
survprobs

Pattern of LTCI take-up and NH entry in the data

LTCI take-up rates



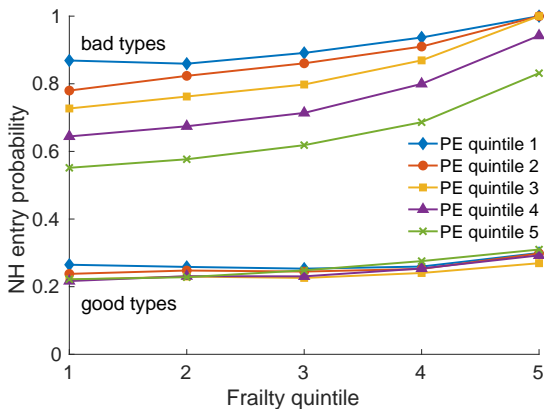
Lifetime NH entry rates



- **Implication:** Dispersion of private NH entry risk has to increase in frailty and decrease in PE/wealth for model to account for the pattern of NH entry and LTCI take-up in the data. [details](#)

Resulting pattern of private information

- Fraction of good types $\psi = 0.709$.
- Nursing home entry probabilities conditional on surviving in the model:



Assessment: Dispersion of Private Information

Standard deviation of self-reported (private) NH entry probabilities by frailty and PE quintile: data and model.

	Frailty quintile				
	1	2	3	4	5
Data	1.00	1.00	1.03	1.27	1.47
Model	1.00	1.08	1.20	1.31	1.47
	Permanent earnings quintile				
	1	2	3	4	5
Data	1.00	0.92	0.85	0.79	0.76
Model	1.00	0.96	0.91	0.78	0.59

The s.d.'s of frailty and PE quintile 1 are normalized to 1. Data values are s.d.'s of self-reported probs. of entering a NH in the next 5 years excluding observations where the probability is 0, 100% or 50%.

- Dispersion of private information increases with frailty and decreases with PE in both the data and model.

Assessment: Comprehensiveness

	Wealth Quintile				
	1	2	3	4	5
Good risks (θ^g)					
Fraction of NH costs covered	NA	NA	0.507	0.507	0.514
Bad risks (θ^b)					
Fraction of NH costs covered	NA	NA	0.711	0.711	0.816
	Frailty Quintile				
	1	2	3	4	5
Good risks (θ^g)					
Fraction of NH costs covered	0.514	0.517	0.518	0.492	0.487
Bad risks (θ^b)					
Fraction of NH costs covered	0.763	0.753	0.774	0.739	0.736

- **Model:** A LTCI contract covers 58% of NH costs on average.
- **Data:** Representative policies cover 34% – 66% of expected lifetime LTC expenses.
- Coverage varies by private type but not much by wealth or frailty.

	Wealth Quintile				
	1	2	3	4	5
Good risks (θ^g)					
Average load	NA	NA	0.631	0.605	0.558
Bad risks (θ^b)					
Average load	NA	NA	-0.082	-0.046	0.056
	Frailty Quintile				
	1	2	3	4	5
Good risks (θ^g)					
Average load	0.514	0.517	0.518	0.492	0.487
Bad risks (θ^b)					
Average load	-0.004	-0.005	-0.017	-0.020	-0.031

- **Model:** Average load is 0.41.
- **Data:** Average loads range from 0.18 to 0.5 depending on whether or no adjustments are made for policy lapses.
- Loads vary by private type but not much by wealth or frailty.

Quantitative results: Denials v. Choice

- Fraction of each type of contract:
 - **Denials:** 90.1% of individuals are offered a single contract of $(0, 0)$.
 - **Choice:** Only 0.11% of individuals are offered two contracts and choose the $(0, 0)$ one.
- Denials in the model are **not** equivalent to denials in data.
- Model denials are a no-trade result.
- Data denials are mainly due to poor health (lower bound on model denials).
- Survey evidence from Ameriks et al. (2016) finds many individuals do not buy LTCI because it is too expensive.

Quantitative results: LTCI ownership and NH entry

- Our finding that risk group selection is important has implications for empirical tests for adverse selection.
- The tests are based on the standard adverse selection model which predicts that, in the presence of adverse selection:
 - LTCI holders should have higher NH entry than non-holders,
 - I.e., *Positive correlation* between NH entry and LTCI ownership.

Finkelstein and McGarry (2006) empirical findings:

- 1 Positive correlation between self-assessed NH entry risk and NH entry within risk groups.
- 2 Positive correlation between self-assessed NH entry risk and LTCI ownership.
- 3 *Negative or zero correlation* between NH entry and LTCI ownership depending on controls.

Baseline economy:

- 1 is true by definition of bad type.
- 2 is true: LTCI take-up rate of bad types is 9.5%, good types is 9.2%. Holds no matter how we condition on observables.

Quantitative results: LTCI ownership and NH entry

NH entry *rates* for LTCI holders and non-holders in the
Baseline economy

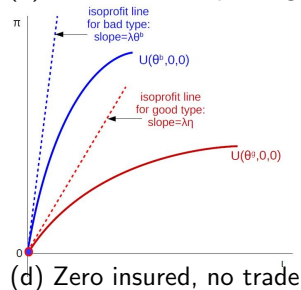
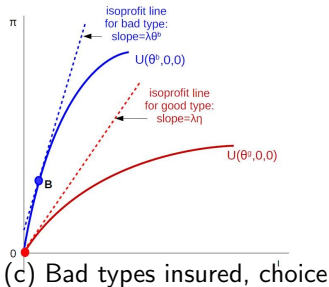
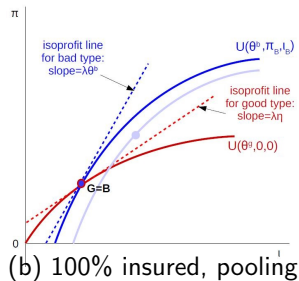
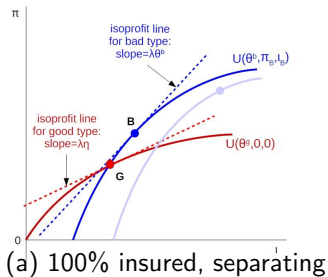
	Frailty Quintile					
	Average	1	2	3	4	5
LTCI holders	36.9	33.4	36.0	37.2	41.2	47.5
Non-holders	40.7	35.9	37.9	40.1	43.0	49.1

Numbers are percent of survivors to the very old stage of life who enter a NH.

3 is true:

- Correlation is negative if no controls.
- Negative if only control for frailty.
- If we control for both wealth quartile and frailty get essentially zero correlation. (Average differential is 0.03%.)

Why do we get neg./zero correlations?



Summary: Why do we get neg./zero correlations?

- Two offsetting effects:
 - ① If perfectly control for observables, ownership-entry correlation is positive but small (only tiny fraction of risk groups have non-zero correlation).
 - ② Due to denials, ownership is negatively correlated with average NH entry across risk groups.
- When risk groups are bunched together, 2 can easily dominate 1. [details](#)
- **Implication:** Tests for adverse selection that use ownership rates have low power.
- Extent of coverage may be better way to test if data is available.

Denial Rates (%)

Scenario Description	Baseline	No Administrative Costs $\lambda = 1, \kappa = 0$	No Medicaid $c_{nh} = 0.001$	Full Information θ_f^i public
Average	90.1	38.7	9.4	62.5
By PE Quintile				
1	100	100	27.4	100
2	100	93.4	0.0	99.6
3	85.7	0.0	0.0	54.1
4	83.9	0.0	0.0	29.1
5	81.2	0.0	19.8	29.7
High PE				
top 10	75.1	0.0	39.5	30.4
top 5	58.8	0.0	76.2	31.7
top 1	100	0.0	100	100

- Medicaid generates denials of poorer individuals.
- Administrative costs and adverse selection generate denials of richer individuals.
- All three factors are important for those in PE Q3–Q4.

Impact of Medicaid on LTCI take-up rates

- The crowding out effect of Medicaid on private LTCI has been documented in Brown and Finkelstein (2008).
- They find that bottom 66% of wealth dist. would not purchase a full-coverage, actuarially-fair contract due to Medicaid.
- The crowding-out effect of Medicaid in our model is much smaller.
- We find in an economy with Medicaid but
 - no private information
 - no administrative costs
 - average load of 0.35 (monopoly power)only 39% do not purchase LTCI.
- Why is crowding out effect so much smaller in our setup?

Crowding-out effects of Medicaid on private LTCI

Most purchasers only want partial coverage.

Economy with no private information and no admin. costs

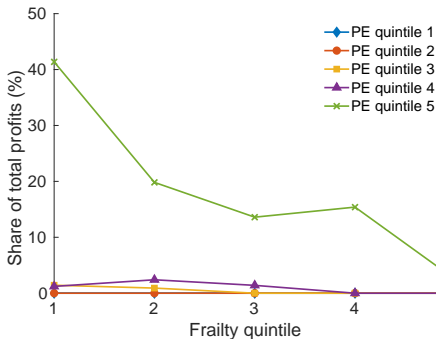
	Wealth Quintile				
	1	2	3	4	5
LTCI take-up rates	0	0.04	1	1	1
Fraction of loss covered	NA	0.50	0.61	0.88	0.97
Average load	NA	0.16	0.30	0.41	0.38

- Only wealth quintile 5 buys full coverage contract.
- Individuals in quintile 2–4 prefer partial coverage.

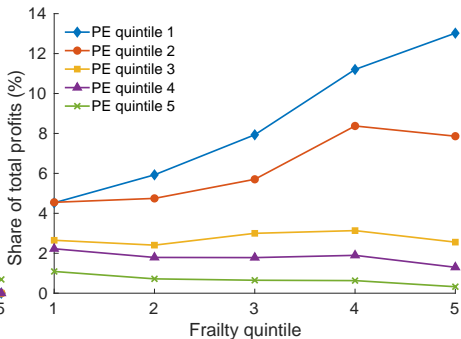
Conclusion: Abstracting from supply-side can distort inference about the role of demand-side distortions.

Quantitative Results: Profits

Baseline



No Medicaid



- Baseline: Profits are low (2.3% of revenues) and obtained from healthy, rich individuals.
- Medicaid has largest impact: removing increases profits to 28.5% of revenues.
- Without Medicaid profits are obtained mostly from poor.

Model provides several new insights:

- Demonstrates that an optimal contracting model with risk group selection can account for the main features of the U.S. LTCI market:
 - low take-up rates,
 - denials and partial coverage contracts,
 - failure of positive correlation property,
 - high loads but low profits.
- Demonstrates the importance of endogenous optimal contracts.
- Provides a resolution to what Ameriks et al. (2016) refer to as the “LTCI puzzle” (demand for ideal LTCI product is high but ownership of actual products is low).

Impact of adverse selection on LTCI take-up rates

- Removing either private information or administrative costs has a big impact on denials among more affluent individuals.
- Do we need private information?
- **Yes!** The full information model:
 - overstates LTCI take-up rates,
 - produces an incorrect pattern of LTCI take-up rates by frailty quintile among more affluent individuals. [Details](#)
- Even if we try to reparameterize the full information model by raising the administrative costs it cannot match the pattern of LTCI take-up among affluent.

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- Lowering ψ from 0.709 to 0.609 produces more contracts that feature choice, but this specification no longer reproduces the correlation puzzle and understates the dispersion of private information in our dataset.
- Private information and administrative costs continue to be important in accounting for low LTCI take-up rates among affluent individuals if the size of the Medicaid consumption floor is increased by a factor of 1.76.
- Administrative costs are also important if the model is to reproduce the low LTCI take-up rates in the data among affluent individuals.

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Empirical Evidence of Adverse Selection

- Finkelstein and McGarry (2006) find that individuals' self-assessed NH entry risk is positively correlated with both actual NH entry and LTCI ownership even after controlling for characteristics observable by insurers.
- Hendren (2012) finds that self-assessed NH entry risk is more predictive of a NH event for individuals who would likely be denied by LTC insurers.
- We repeat logit regression analysis of Hendren (2012) for stays of 100 days or more. Find:
 - Strong evidence of private information at a 10 year horizon for sample with high likelihood of denial.
 - Much weaker evidence of private information using the sample who pass underwriting.

Round 1: Pre-screening

Common questions include:

- 1 Do you require human assistance to perform any of your activities of daily living?
- 2 Are you currently receiving home health care or have you recently been in a nursing home?
- 3 Have you ever been diagnosed with or consulted a medical professional for the following: a long list of diseases that includes diabetes, memory loss, cancer, mental illness, heart disease?
- 4 Do you currently use or need any of the following: wheelchair, walker, cane, oxygen, etc.?
- 5 Do you currently receive disability benefits, social security disability benefits, or Medicaid?

Source: 2010 Report on the Actuarial Marketing and Legal Analyses of the Class Program

The HRS contains enough information to more or less answer each of these questions for HRS respondents.

Round 1: Pre-screening

Percentage Answering “Yes” to at Least One Question

	Age		
	55–56	60–61	65–66
All	41.8	43.7	49.5
Top Half of Wealth Distribution Only			
All	30.8	33.6	39.3

- The percentage answering “Yes” to at least one question is large even for the youngest age group and the top half of the wealth distribution.

Round 1: Pre-screening

Percentage Answering “Yes” to at Least One Question

	Age		
	55–56	60–61	65–66
All	41.8	43.7	49.5
Top Half of Wealth Distribution Only			
All	30.8	33.6	39.3

- Q3 was answered “Yes” with highest frequency.
- If Q3’s yes’s are not counted \Rightarrow Round 1 declination rates range from 17.5–22.5%.

Round 2: Formal application

- Conditional on passing round 1, individuals are invited to make a formal application.
- One in five formal applicants are denied coverage. (Source: American Association for Long-Term Care Insurance)
- Assuming the declination rate is 20–45% in round 1 and 20% in round 2 \Rightarrow roughly 36–56% of 55–66 year-old HRS respondents would be unable to obtain LTCI.

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- Since Rothschild and Stiglitz (1976) the focus of both theoretical and empirical research has been on coverage and pricing of the *insurable*. See Chiappori and Salanié (2000), Finkelstein and McGarry (2006), Chade and Schlee (2012), Lester et al. (2017), Fang et al. (2008).
- Exceptions:
 - Hendren (2012) describes a specific example where an entire risk group is denied coverage.
 - Chade and Schlee (2017) show how adverse selection in conjunction with administrative costs and monopoly power can produce no-trade contracts.

Intuition: Increasing λ

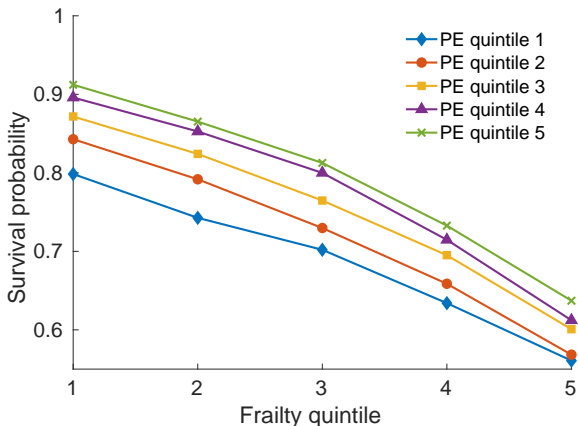
- Increasing λ increases MC of providing insurance.
- Premia and indemnity decline.
- Because the MC of insuring bad types is larger, bad types premia and indemnity decline more than good types.
- Eventually the insurer can no longer increase profits by offering a separating menu.
- As λ increases further pooling contract moves along good types PC constraint to $(0, 0)$.

[add. details](#)

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Calibration: Survival probabilities

Survival probabilities in the data and model. Based on auxiliary model estimated using HRS data.



The probability of surviving to age 80 or until experiencing a nursing home stay by frailty and PE quintile. [Back](#)

Generating zero or negative correlations

If $\lambda > 1$ or $\underline{c}_{NH} > 0$, the correlation between LTCI ownership and NH entry in our setup can be zero, positive, or negative.

- Within a risk group:
 - Either both types have LTCI, neither type, or only bad types.
 - So correlation between LTCI ownership and NH entry is either zero or positive.
- However, due to denials, ownership can be negatively correlated with average NH entry across risk groups.
- If econometrician does not fully control for information set of insurer
 - The negative correlation across risk groups can dominate positive correlation within risk groupsand the econometrician can find a negative correlation.

Calibration: Parameters

- **Preferences** CRRA with risk aversion coefficient of 2.
- **Annual discount factor** (β) is 0.94. Target is ave. wealth at retirement/ave. lifetime earnings.
- **Retirement discount factor** $\alpha = 0.20$. Target is ave. wealth at NH entry/ave. lifetime earnings.
- **Annual interest rate** r is 0.0.
- **NH cost** m set to care cost of average long-term NH stay: \$100,351 in 2000.
- **Administrative costs** $\lambda = 1.195$ and $k = 0.019$ set to get total costs/total premia = 30% and average load on individuals of 0.40.
- **Consumption floors** $\underline{c}_{NH} = \underline{c}_0 = 0.01855$ set to \$7,053 a year based on estimates in literature.

Calibration: Frailty and Earnings Distributions

- Joint distn. of $\{f, w_y\}$ is Gaussian copula.
- Marg. distn. of f is beta. Target is the frailty distribution of 62–72 year-olds in HRS.
- Marg. distn. of w_y is log-normal. Target is permanent earnings distribution of HRS retirees.
- Correlation $\rho = -0.29$. Target is:

Mean frailty by permanent earnings quintile in HRS data

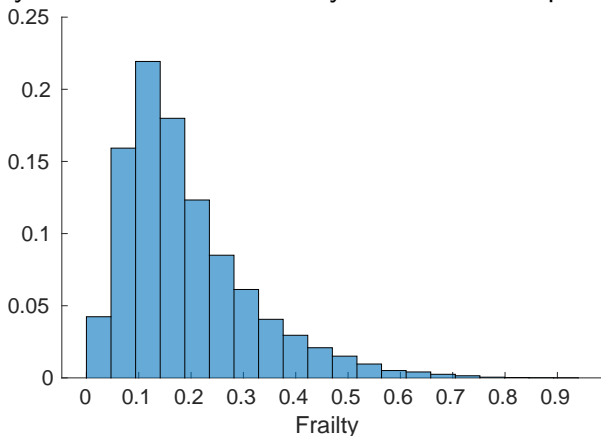
Q1	Q2	Q3	Q4	Q5
0.23	0.22	0.19	0.16	0.15

- Old income $w_o \in [0.60w_y, 0.40w_y]$. Targets are variation in wealth and average SS replacement rate.
- Consumption shock distn. $1 - \kappa$ is log-normal. Target is wealth distribution of NH entrants in period before NH entry.

Calibration: Distributions

- We construct a frailty index for HRS respondents that summarizes underwriting criteria used by LTC insurers.

Frailty distribution for 62–72 year-old HRS respondents



Assessment: Insurance Distribution

Distribution of insurance across NH residents: data and model

	LTCI	Medicaid	Both	Neither
Data	8.2	45.6	2.7	43.4
Model	9.2	47.6	0.3	42.6

- Distribution of insurance across NH residents in model and data are similar.
- Model understates fraction with both public and private insurance.

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$$\begin{aligned}
 \text{MRS}(\theta^g, \pi^g, \iota^g) &\approx \lambda\eta, \\
 \text{MRS}(\theta^b, \pi^b, \iota^b) &= \lambda\theta^b, \\
 \text{U}(\theta^g, \pi^g, \iota^g) - \text{U}(\theta^g, 0, 0) &= 0, \\
 \text{U}(\theta^b, \pi^b, \iota^b) - \text{U}(\theta^b, \pi^g, \iota^g) &= 0,
 \end{aligned}$$

where

$$\eta = \psi\theta^g + (1 - \psi)\theta^b,$$

and

$$\begin{aligned}
 \text{MRS}(\theta^i, \pi^i, \iota^i) &= \\
 &\frac{\theta^i u'(\max[\underline{c}, w_o - \pi^i - m + \iota^i])}{\theta^i u'(\max[\underline{c}, w_o - \pi^i - m + \iota^i]) + (1 - \theta^i) u'(w_o - \pi^i)}.
 \end{aligned}$$

Conditions for denials with $\lambda > 1$

The pool will be denied if and only if

$$\text{MRS}(\theta_{f,w}^b) = -\frac{u_{2,\text{NH}}(\theta_{f,w}^b, 0, 0)}{u_{2,o}(\theta_{f,w}^b, 0, 0)} \leq \lambda s_{f,w} \theta_{f,w}^b, \quad (1)$$

and

$$\text{MRS}(\theta_{f,w}^g) = -\frac{u_{2,\text{NH}}(\theta_{f,w}^g, 0, 0)}{u_{2,o}(\theta_{f,w}^g, 0, 0)} \leq \lambda s_{f,w} \eta_{f,w}, \quad (2)$$

hold where $\eta_{f,w} = \psi \theta_{f,w}^g + (1 - \psi) \theta_{f,w}^b$, is the fraction of individuals with frailty f and endowments w who will enter a NH.

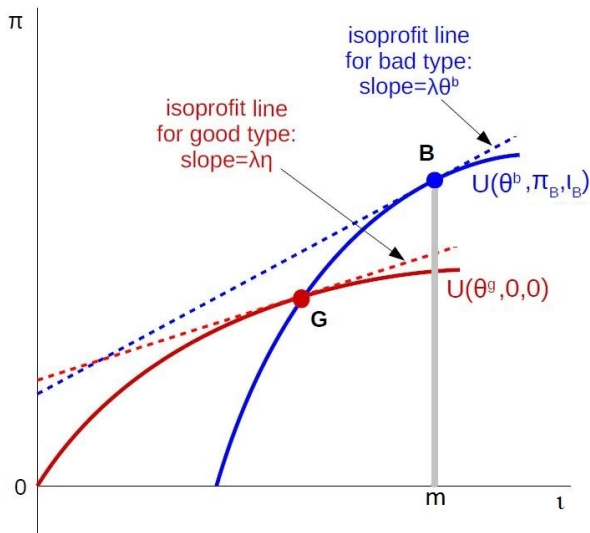
Basic intuition:

- (1) rules out separating contracts where only bad types get insurance.
- (2) rules out pooling contracts and separating contracts where both types get insurance.

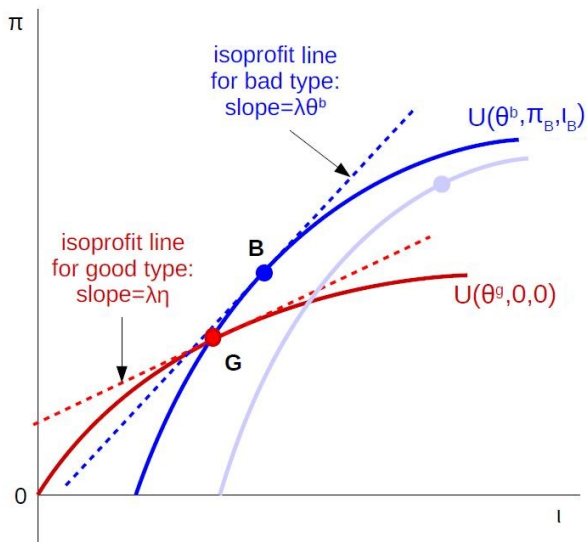
The U.S. private LTCI market: the industry

- Market has experienced a boom – bust cycle.
 - Boom years: late 1980s – 1990s. Sales more than doubled. Over 100 companies in 2003.
 - Bust years: 2003 – present. Massive exit. Most companies have stopped writing policies. In 2013, 66% of all new policies were sold by three insurers.

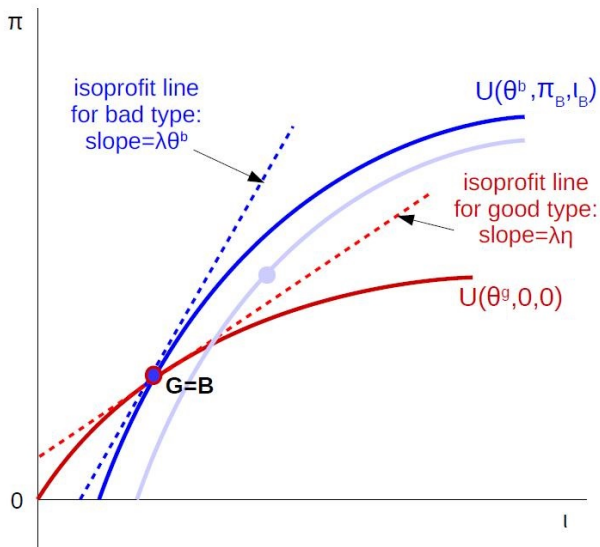
Optimal Contract with Load: $\lambda = 1$



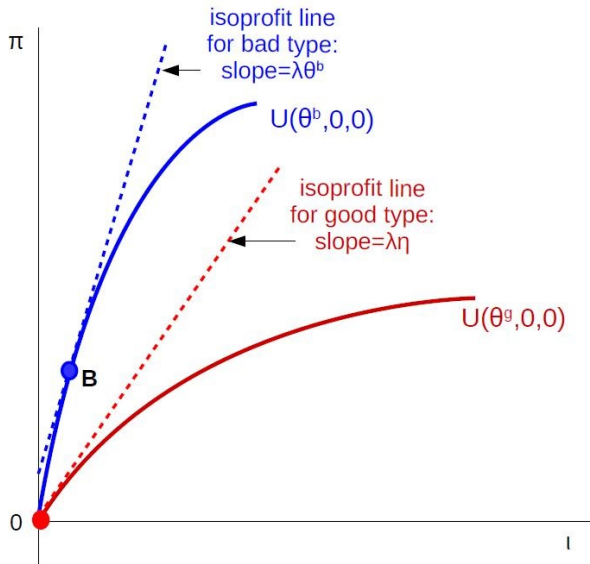
Optimal Contract with Load: $\lambda > 1$



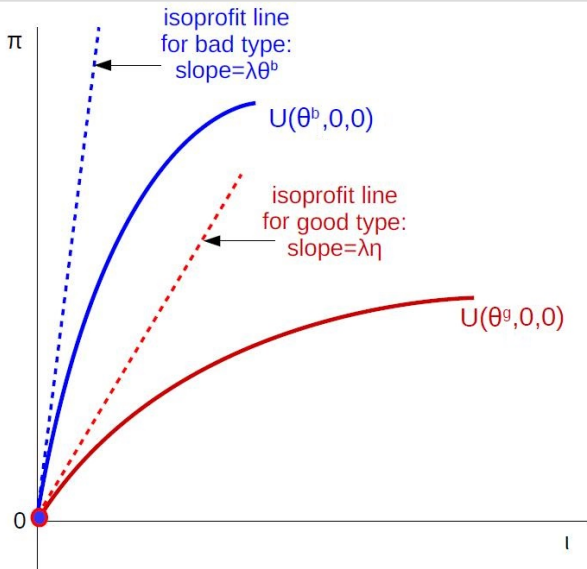
Optimal Contract with Load: Pooling



Optimal Contract with Load: Good Denied



Optimal Contract with Load: Both Denied



Properties of the Model: Standard Setup

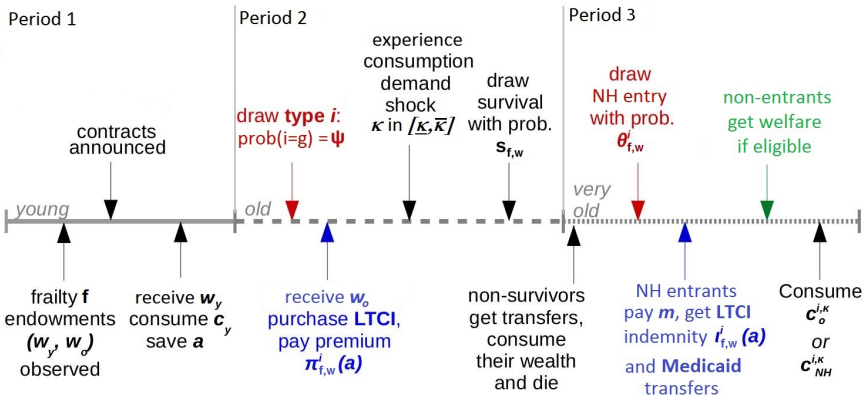
If $\theta^g < \theta^b < 1$, $\lambda = 1$, and $\underline{c} = 0$ the model generates the *classic* findings in Stiglitz (1977) and Chade and Schlee (2012):

- 1 *Separating equilibria.* Agents are offered two contracts. Type θ^b prefers one of the contracts and type θ^g prefers the other contract.
- 2 *Full insurance at the top.* Type θ^b agents get full insurance but the contract is not actuarially fair (single issuer).
- 3 *Downward distortion for good risks.* The indemnity for type θ^g agents is distorted downward.
- 4 *Positive correlation property.* Correlation between LTCI ownership and NH entry is positive (only θ^g agents may have no insurance).

Our Findings

- ① LTCI take-up rates are low due to denials.
- ② Adverse selection, market power and administrative costs generate denials and thus low LTCI take-up rates of wealthy individuals.
- ③ Medicaid generate denials and low LTCI take-up rates of poor individuals.
- ④ Both factors are important for the middle class.
- ⑤ Model also accounts for the other features of this market we described above.

Model Timeline



Parametrization of Medicaid consumption floor

- Consumption floor is \$6,540 a year (year 2000 dollars).
- Consists of a consumption allowance of \$30 per month and housing and food expenses of \$515 per month.
- The former number is Medicaid consumption allowance to NH residents and the latter is the monthly amount that SSI paid to single elderly individuals in 2000.
- Number of years is 2.976. (average duration of long-term NH stay).
- Resulting value of \underline{c}_{NH} is 1.855% of mean permanent earnings.

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Parametrization of demand shock distribution

- $1 - \kappa$ is truncated log-normal over $[0.2, 0.8]$.
- Target for mean is average wealth of NH entrants relative to average wealth of 62–72 year-olds: 0.62 in data and 0.68 in model.
- Target for variance is the ratio of average wealth in quintile 5 of NH entrants immediately before entering the NH relative to the average wealth in quintile 5 at age 62–72: 0.70 in data and 0.66 in model.
- The resulting mean and standard deviation of κ are 0.60 and 0.071.
- So, on average, individuals lose 60% of wealth between retirement and NH entry.

Calibrating NH entry probability distributions

Frailty Quintile	Data			Model		
	Wealth Quintiles			Wealth Quintiles		
	1-3	4	5	1-3	4	5
1	0.071	0.147	0.233	0.073	0.145	0.245
2	0.065	0.158	0.205	0.069	0.165	0.202
3	0.049	0.131	0.200	0.048	0.128	0.245
4	0.037	0.113	0.157	0.032	0.122	0.151
5	0.025	0.107	0.104	0.029	0.102	0.118

LTCI take-up rates increase with wealth and decline with frailty in model and data. [Back](#)

LTCl Take-up Rates: Data, Baseline and Full Information Models

Frailty Quintile	Data		Baseline		Full Info.	
	Wealth Quintile 4	Wealth Quintile 5	Wealth Quintile 4	Wealth Quintile 5	Wealth Quintile 4	Wealth Quintile 5
1	0.147	0.233	0.145	0.245	0.709	0.694
2	0.158	0.205	0.165	0.202	0.709	0.709
3	0.131	0.200	0.128	0.245	0.709	0.708
4	0.113	0.157	0.122	0.151	0.709	0.711
5	0.107	0.104	0.102	0.118	0.709	0.699

For frailty (rows) Quintile 5 has the highest frailty and for wealth (columns) Quintile 5 has the highest wealth.

- **Data and Baseline Model:** LTCl take-up rates decline with frailty.
- **Full Information Model:** LTCl take-up rates are constant or hump-shaped in frailty.