Topic 7: Adverse Selection and Insurance Market Failures

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Harvard

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\[^1\text{Thanks to Raj Chetty and Amy Finkelstein for generously providing their lecture notes, some of which are reproduced here.}\]
The government is a large provider of social insurance
- Health Insurance (Medicaid, Medicare)
- Unemployment insurance
- Disability insurance
- Annuities (Social security)

Why does the government provide this insurance?
- Why not private markets?
Potential market failures:
- Moral hazard?
- Adverse selection?
- Irrationality?
- Others?

This lecture: unique role of adverse selection in generating role for government intervention
1 Modeling insurance markets
     - Market unraveling and equilibrium non-existence (see also Hendren (2014, “Unraveling vs. Unraveling”...))

2 Empirical analysis of insurance markets
   - Positive correlation test (Chiappori and Salanie, 2000)
   - Exogenous variation in prices (Einav, Finkelstein, and Cullen, 2010)
   - Subjective probability elicitations (Hendren, 2013, 2017)
Begin with classic model of Akerlof (1970)

- As adapted to insurance markets by Einav and Finkelstein (2011, JEP)

Individuals have demand \( D(s) \), where \( s \in [0, 1] \)

- WLOG \( D' < 0 \) (by definition of \( s \))

Individuals with demand \( D(s) \) have cost \( C(s) \) that they impose on the insurance company

Akerlof (1970): Competitive equilibrium requires demand = average cost,

\[
D(s^{CE}) = AC(s^{CE}) = E \left[ C(s) \mid s \leq s^{CE} \right]
\]
Figure 1
Adverse Selection in the Textbook Setting

Source: Einav and Finkelstein (2011 JEP)
Not clear that competitive equilibrium involves any insurance

- Market can “unravel”
- Market unravels if no one is willing to pay the pooled cost of those with higher demand (and thus likely to be higher risk)
Source: Einav and Finkelstein (2011 JEP)
Akerlof (1970): readily applied to market for cars
- Explains why cars lose value the day after they’re sold?
  - Also argued that market for health insurance above age 65 does not exist because of adverse selection
  - Market unraveled because of adverse selection “death spiral”

But problem with model: single contract traded, so competition only on price
- Rothschild and Stiglitz (1976)
  - Compete on more than 1 dimension of the contract
  - Can “screen” different risks into different contracts
- Key problem: Unclear how to model equilibrium
  - Standard game-theoretic notions of (pure strategy) equilibria may not exist -> “Market unraveling”
Model

Model Environment (generalization of Rothschild and Stiglitz (1976))

- Unit mass of agents endowed with wealth $w$
- Face potential loss of size $l$ with privately known probability $p$
  - Distributed with c.d.f. $F(p)$ with support $\Psi$
    - Could be continuous, discrete or mixed
  - Rothschild and Stiglitz (1976): $p \in \{p_L, p_H\}$ (2 types)
    - Let $P$ denote random draw from population (c.d.f. $F(p)$)
- Agents vNM preferences

$$pu(c_L) + (1 - p) u(c_{NL})$$
Insurers / timing

- Insurance structure: Rothschild and Stiglitz (1976) with menus
- There exists a set of risk-neutral insurance companies, $j \in J$ seeking to maximize expected profits by choosing a menu of consumption bundles:
  \[ A_j = \left\{ c^j_L(p), c^j_{NL}(p) \right\}_{p \in \Psi} \]
- First, insurers simultaneously offer a menu of consumption bundles
- Given the set of available consumption bundles,
  \[ A = \bigcup_j A_j \]
  individuals choose the bundle that maximizes their utility
Equilibrium

**Definition**

An allocation \( A = \{c_L(p), c_{NL}(p)\}_{p \in \Psi} \) is a **Competitive Nash Equilibrium** if

1. **A is incentive compatible**

   \[ pu(c_L(p)) + (1 - p) u(c_{NL}(p)) \geq pu(c_L(\tilde{p})) + (1 - p) u(c_{NL}(\tilde{p})) \quad \forall p, \tilde{p} \]

2. **A is individually rational**

   \[ pu(c_L(p)) + (1 - p) u(c_{NL}(p)) \geq pu(w - l) + (1 - p) u(w) \quad \forall p \in \Psi \]

3. **A has no profitable deviations** [Next Slide]
No Profitable Deviations

For any other menu, $\hat{A} = \{\hat{c}_L(p), \hat{c}_{NL}(p)\}_{p \in \Psi}$, it must be that

$$\int_{p \in D(\hat{A})} \left[ p(w - l - c_L(p)) + (1 - p)(w - c_{NL}(p)) \right] dF(p) \leq 0$$

where

$$D(\hat{A}) = \left\{ p \in \Psi \mid \max_{\hat{p}} \left\{ pu(\hat{c}_L(\hat{p})) + (1 - p) u(\hat{c}_{NL}(\hat{p})) \right\} > pu(c_L(p)) + (1 - p) u(c_{NL}(p)) \right\}$$

- $D(\hat{A})$ is the set of people attracted to $\hat{A}$
- Require that the profits earned from these people are non-positive
Two Definitions of Unraveling

- **Akerlof unraveling**
  - Occurs when demand curve falls everywhere below the average cost curve
  - Market unravels and no one gets insurance

- **Rothschild and Stiglitz unraveling**
  - Realize a Competitive Nash Equilibrium may not exist
  - Market unravels a la Rothschild and Stiglitz when there does not exist a Competitive Nash Equilibrium
(Hendren 2013) The endowment, \{(w - l, w)\}, is a competitive equilibrium if and only if

\[
p \frac{u'(w - l)}{1 - p} \leq \frac{E[P|P \geq p]}{1 - E[P|P \geq p]} \quad \forall p \in \Psi \setminus \{1\}
\]

(1)

where \(\Psi \setminus \{1\}\) denotes the support of \(F(p)\) excluding the point \(p = 1\).

- The market unravels a la Akerlof when no one is willing to pay the pooled cost of worse risks (Hendren 2013)
  - Theorem extends Akerlof unraveling to set of all potential traded contracts, as opposed to single contract
  - No gains to trade \(\Rightarrow\) no profitable deviations by insurance companies
Akerlof Unraveling (2)

\[ E[P|P>p] \]
\[ 1 - E[P|P>p] \]
\[ pu'(w-l) \]
\[ (1-p)u'(w) \]

Diagram:
- \( c_L \) vs. \( w-l \)
- \( w \) vs. \( c_{NL} \)
- 45 degree line
- Intersection points:
  - \( E[P|P>p] \)
  - \( 1 - E[P|P>p] \)
  - \( pu'(w-l) \)
  - \( (1-p)u'(w) \)
Akerlof Unraveling (3)

\[ E[P|P>p] \]
\[ 1 - E[P|P>p] \]
\[ pu'(w-l) \]
\[ (1-p)u'(w) \]
Aside: High Risks

- Corollary: If the market fully unravels a la Akerlof, there must exist arbitrarily high risks:

  \[ F(p) < 1 \quad \forall p < 1 \]

- Need full support of type distribution to get complete Akerlof unraveling
  - Can be relaxed with some transactions costs (see Chade and Schlee, 2013)
When does a Competitive Nash Equilibrium exist?

- Follow Rothschild and Stiglitz (1976) and Riley (1979)
- Generic fact: Competition $\rightarrow$ zero profits
- Key insight of Rothschild and Stiglitz (1976): Nash equilibriums can’t sustain pooling of types
Rothschild and Stiglitz: No Pooling
Rothschild and Stiglitz: No Pooling (2)
Rothschild and Stiglitz: No Pooling (3)
Regularity condition

- No pooling + zero profits $\implies$ No cross subsidization:
  \[ pc_L(p) + (1 - p) c_{NL}(p) = w - pl \quad \forall p \in \Psi \]

- Insurers earn zero profits on each type

A Regularity Condition

Suppose that either:

1. There exists an interval over which $P$ has a continuous distribution
2. $P = 1$ occurs with positive probability

Satisfied if either $F$ is continuous or $F$ is discrete with $p = 1$ in the support of the distribution

Can approximate any distribution with distributions satisfying the regularity condition
Theorem

Suppose the regularity condition holds. Then, there exists a Competitive Nash Equilibrium if and only if the market unravels a la Akerlof (1970)

- Either no one is willing to cross-subsidize -> no profitable deviations that provide insurance
- Or, people are willing to cross-subsidize -> generically, this can’t be sustained as a Competitive Nash Equilibrium
- Proof: Need to show that Nash equilibrium does not exist when Akerlof unraveling condition does not hold
  - Case 1: $P = 1$ has positive probability
    - Risks $p < 1$ need to subsidize $p = 1$ type in order to get insurance
  - Case 2: $P$ is continuous and bounded away from $P = 1$.
    - We know Akerlof unraveling condition cannot hold
    - Follow Riley (1979) – shows there’s an incentive to pool types -> breaks potential for Nash equilibrium existence
Generic No Equilibrium (Riley)
Generic No Equilibrium (Riley) (2)
Generically, either the market unravels a la Akerlof or Rothschild and Stiglitz

No gains to trade $\rightarrow$ unravels a la Akerlof
  - No profitable deviations $\rightarrow$ competitive equilibrium exists

Gains to trade $\rightarrow$ no unraveling a la Akerlof
  - But there are profitable deviations
  - Generically, no Competitive Equilibrium (unravels a la Rothschild and Stiglitz)

We don’t have a model of insurance markets!
  - Generically, the standard Nash model generically fails to make predictions precisely when there are theoretical gains to trade
Two classes of models in response to non-existence

Consider 2-stage games:

Stage 1: firms post menu of contracts

Stage 2: Assumption depends on equilibrium notion:
  - Miyazaki-Wilson-Spence: Firms can drop unprofitable contracts
    - Formalized as dynamic game in Netzer and Scheuer (2013)
  - Riley: Firms can add contracts
    - Formalized as dynamic game in Mimra and Wambach (2011)

Then, individuals choose insurance contracts
Miyazaki (1979); Wilson (1977); Spence (1978)

Two Stage Game:
- Firms choose contracts
  - Menus (Miyazaki)
  - Single contracts (Wilson / Spence)
- Firms observe other contracts and can drop (but not add) contracts/menus
  - In Miyazaki, firms have to drop the entire menu
- Individuals choose insurance from remaining set of contracts
- Reaching the Pareto frontier requires allowing some contracts to run deficits/surplus
  - Individuals generically are willing to “buy off” worse risks’ incentive constraints
- Miyazaki Wilson Spence allows for this if the good types want to subsidize the bad types
  - If you try to steal my profitable contract, I drop the corresponding negative profit contract and you get dumped on!
- MWS equilibrium maximizes welfare of best risk type by making suitable compensations to all other risk types to relax IC constraint
  - Fully separating solution in Miyazaki
  - Can be pooling in Wilson / Spence
Predicts “fully separating” contracts with no cross-subsidization across types
  - IC constraint + zero profit constraints determine equilibrium
Why no cross-subsidization?
  - If cross-subsidization, then firms can add contracts.
  - But, firms forecast this response and therefore no one offers these subsidizing contracts
Predicts no trade if full support type distribution
Other non-game-theoretic approaches

- Walrasian:
  - Bisin and Gotardi (2006)
    - Allow for trading of choice externalities -> reach efficient frontier/MWS equilibrium (pretty unrealistic setup...)
  - Azevedo and Gottlieb (2016) -> reach inefficient Riley equilibria

- Search / limited capacity / limited liability / cooperative solutions / etc.
  - Guerrieri and Shimer (2010) -> reach inefficient Riley equilibria
Empirical Question?

- Need theory of a mapping from type distributions to outcomes
  - Standard model works if prediction is no trade
    - This happens for those with “pre-existing conditions” in LTC, life, and disability insurance (Hendren 2013)
  - But, standard model fails when market desires cross-subsidization
    - Key debate: can competition deliver cross-subsidization?
    - Should be empirical question!?

- In short, insurance markets are fun because no one agrees about how to model them!
- In practice, just take contract space as given and ignore potential non-existence issues
Empirical Literature

- Positive correlation test (Chiappori and Salanie, 2000)
- Random variation in prices (Einav, Finkelstein, and Cullen, 2010)
- Subjective probability elicitations (Hendren, 2013)
Chiappori and Salanie (2000)
- Asymmetric information $\rightarrow$ positive correlation between claims and coverage
  - Holds in both Wilson (1977) and Riley (1979)
- Is there a positive correlation between insurance purchase and insurance claims?

Specification:

$$INS = \beta X + \epsilon$$

$$COST = \Gamma X + \eta$$

Test: $\text{cov} (\epsilon, \eta) \neq 0$
Empirical Test: Positive Correlation Test

- Chiappori and Salanie (2000)
  - Data: French auto insurance company
  - Key: control flexibly for $X$s
  - Find no evidence of adverse selection
  - Can’t reject $\text{cov}(\epsilon, \eta) = 0$
Finkelstein and Poterba study annuities in the UK

**Specification**

\[
Cost = \gamma INS + \beta X + \epsilon
\]

- Consider two measures of INS
  - Size of annuity
  - Size of guarantee (paid if die early)
- Find no evidence of INS quantity; but evidence on guarantee amount
Limitations of Positive Correlation Test: Preference Heterogeneity

- Standard theory: people differ only in their risk type
  - Different expected costs to the insurer
- Reality: People are different in many other ways too
  - Cost to the insurer may not be only driver of demand
- Preference heterogeneity may not be independent of risk type
  - The “worried well” may help sustain insurance markets
  - Could lead to “advantageous selection” instead of adverse selection
Many papers find evidence that preferences other than risk type affect demand.

Finkelstein and McGarry (2006, AER) document that seat-belt use and income are correlated with LTC insurance purchase.

- Suggest this could explain why we see no adverse selection in LTC.
<table>
<thead>
<tr>
<th></th>
<th>No controls (1)</th>
<th>Control for insurance company prediction (2)</th>
<th>Control for application information (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual prediction</td>
<td>0.091***</td>
<td>0.043**</td>
<td>0.037*</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.020)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Insurance company prediction</td>
<td></td>
<td>0.400***</td>
<td>0.395***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td>pseudo-$R^2$</td>
<td>0.005</td>
<td>0.097</td>
<td>0.183</td>
</tr>
<tr>
<td>$N$</td>
<td>5,072</td>
<td>5,072</td>
<td>4,780</td>
</tr>
</tbody>
</table>

Notes: Reported coefficients are marginal effects from probit estimation of equation (1). Dependent variable is an indicator for any nursing home use from 1995 through 2000 (mean is 0.16). Both individual and insurance company predictions are measured in 1995. Heteroskedasticity-adjusted robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Column 4—which includes controls for “application information”—includes controls for age (in single year dummies), sex, marital status, age of spouse, over-35 health indicators, and a complete set of two-way and three-way interactions for all of the variables used in the insurance company prediction (age dummies, sex, limitations to activities of daily living, limitations to instrumental activities of daily living, and cognitive impairment); see text for more details.
### Table 2—Relationship between Individual Beliefs and Insurance Coverage

<table>
<thead>
<tr>
<th></th>
<th>No controls (1)</th>
<th>Control for insurance company prediction (2)</th>
<th>Control for application information (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual prediction</td>
<td>0.086***</td>
<td>0.099***</td>
<td>0.083***</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Insurance company prediction</td>
<td>-0.125***</td>
<td>-0.140***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td></td>
</tr>
<tr>
<td>pseudo-$R^2$</td>
<td>0.007</td>
<td>0.010</td>
<td>0.079</td>
</tr>
<tr>
<td>$N$</td>
<td>5,072</td>
<td>5,072</td>
<td>4,780</td>
</tr>
</tbody>
</table>

*Notes:* Reported coefficients are marginal effects from probit estimation of equation (2). Dependent variable is an indicator for whether individual has long-term care insurance coverage in 1995 (mean is 0.11). Both individual and insurance company predictions are measured in 1995. Heteroskedasticity-adjusted robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Column 4—which includes controls for “application information”—includes controls for age (in single year dummies), sex, marital status, age of spouse, over-35 health indicators, and a complete set of two-way and three-way interactions for all of the variables used in the insurance company prediction (age dummies, sex, limitations to activities of daily living, limitations to instrumental activities of daily living, and cognitive impairment); see text for more details.
Table 3—The Relationship Between Long-term Care Insurance and Nursing Home Entry

<table>
<thead>
<tr>
<th></th>
<th>No controls (1)</th>
<th>Controls for insurance company prediction (2)</th>
<th>Controls for application information (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient from bivariate probit of LTCINS and CARE</td>
<td>(-0.105^{***})</td>
<td>(-0.047)</td>
<td>(-0.028)</td>
</tr>
<tr>
<td>(p = 0.006)</td>
<td></td>
<td>(p = 0.25)</td>
<td>(p = 0.51)</td>
</tr>
<tr>
<td>Coefficient from probit of CARE on LTCINS</td>
<td>(-0.046^{***})</td>
<td>(-0.021)</td>
<td>(-0.014)</td>
</tr>
<tr>
<td>(0.015)</td>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>(N)</td>
<td>5,072</td>
<td>5,072</td>
<td>4,780</td>
</tr>
</tbody>
</table>

Notes: Top row reports the correlation of the residual from estimation of a bivariate probit of any nursing home use (1995–2000) and long-term care insurance coverage (1995); \(p\) values are given in parentheses. Bottom row reports marginal effect on indicator variable for long-term care insurance in 1995 from probit estimation of equation (3). The dependent variable is an indicator variable for any nursing home use from 1995 through 2000; heteroskedasticity-adjusted robust standard errors are in parentheses. For all rows, control variables are described in column headings; see text for more information. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Means of CARE and LTCINS are 0.16 and 0.11, respectively.
### Table 4—Relationship between LTCINS and CARE
*(Sample restricted to individuals with same choice set)*

<table>
<thead>
<tr>
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<th>No controls (1)</th>
<th>Controls for insurance company prediction (2)</th>
<th>Controls for application information (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient from bivariate probit of LTCINS and CARE</td>
<td>−0.123* (p = 0.08)</td>
<td>−0.122* (p = 0.10)</td>
<td>−0.191** (p = 0.017)</td>
</tr>
<tr>
<td>Coefficient from regression of CARE on LTCINS</td>
<td>−0.032* (0.018)</td>
<td>−0.028* (0.015)</td>
<td>−0.033** (0.012)</td>
</tr>
<tr>
<td>N</td>
<td>1,504</td>
<td>1,504</td>
<td>1,438</td>
</tr>
</tbody>
</table>

*Notes:* Sample is limited to individuals in the top quartile of the wealth and income distribution and who have none of the health characteristics that might make them ineligible for private insurance. Top row reports the correlation of the residual from estimation of a bivariate probit of any nursing home use (1995–2000) and long-term care insurance coverage (1995); *p* values are given in parentheses. Bottom row reports marginal effect on indicator variable for long-term care insurance in 1995 from probit estimation in equation (3). The dependent variable is an indicator variable for any nursing home use from 1995 through 2000; heteroskedasticity-adjusted robust standard errors are in parentheses. For all rows, control variables are described in column headings; see text for more information. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Means of CARE and LTCINS are 0.09 and 0.17, respectively.
Table 5—Preference-Based Selection

<table>
<thead>
<tr>
<th></th>
<th>No controls</th>
<th></th>
<th>Control for insurance company prediction</th>
<th></th>
<th>Control for application information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NH Entry (1)</td>
<td>LTC Insurance (2)</td>
<td>NH Entry (3)</td>
<td>LTC Insurance (4)</td>
<td>NH Entry (5)</td>
<td>LTC Insurance (6)</td>
</tr>
<tr>
<td>Panel A: Wealth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top wealth quartile</td>
<td>$-0.095^{***}$</td>
<td>$0.150^{***}$</td>
<td>$-0.038^{**}$</td>
<td>$0.131^{***}$</td>
<td>$-0.018$</td>
<td>$0.139^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.020)</td>
<td>(0.014)</td>
<td>(0.020)</td>
<td>(0.015)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Wealth quartile 2</td>
<td>$-0.073^{***}$</td>
<td>$0.104^{***}$</td>
<td>$-0.025^{*}$</td>
<td>$0.089^{***}$</td>
<td>$-0.013$</td>
<td>$0.092^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.020)</td>
<td>(0.014)</td>
<td>(0.020)</td>
<td>(0.014)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Wealth quartile 3</td>
<td>$-0.030^{**}$</td>
<td>$0.062^{***}$</td>
<td>$0.0004</td>
<td>$0.052^{***}$</td>
<td>$0.006$</td>
<td>$0.057^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.020)</td>
<td>(0.016)</td>
<td>(0.019)</td>
<td>(0.015)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Bottom wealth quartile (omitted)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Individual prediction</td>
<td>$0.086^{***}$</td>
<td>$0.089^{***}$</td>
<td>$0.042^{**}$</td>
<td>$0.098^{***}$</td>
<td>$0.035^{*}$</td>
<td>$0.086^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.017)</td>
<td>(0.020)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Panel B: Preventive health activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventive activity</td>
<td>$-0.106^{***}$</td>
<td>$0.066^{***}$</td>
<td>$-0.054^{***}$</td>
<td>$0.052^{***}$</td>
<td>$-0.016$</td>
<td>$0.016$</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.017)</td>
<td>(0.018)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Individual prediction</td>
<td>$0.095^{***}$</td>
<td>$0.082^{***}$</td>
<td>$0.047^{**}$</td>
<td>$0.095^{***}$</td>
<td>$0.037^{*}$</td>
<td>$0.082^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.017)</td>
<td>(0.020)</td>
<td>(0.017)</td>
<td>(0.020)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Panel C: Seat belt use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always wear seatbelt</td>
<td>$-0.059^{***}$</td>
<td>$0.053^{***}$</td>
<td>$-0.031^{**}$</td>
<td>$0.048^{***}$</td>
<td>$-0.018$</td>
<td>$0.029^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.010)</td>
<td>(0.013)</td>
<td>(0.010)</td>
<td>(0.012)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Individual prediction</td>
<td>$0.092^{***}$</td>
<td>$0.084^{***}$</td>
<td>$0.044^{**}$</td>
<td>$0.097^{***}$</td>
<td>$0.038^{*}$</td>
<td>$0.082^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.017)</td>
<td>(0.020)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.016)</td>
</tr>
</tbody>
</table>

Notes: Table reports marginal effects from probit estimation of equations (1) and (2). Additional controls are given in column headings; see text for more information. In panel A, omitted wealth category is quartile 4. For panel A, income controls are omitted from the “application information” controls since they are highly multi-collinear with assets. In panel B, “preventive activity” measures the proportion of gender-appropriate preventive health behaviors undertaken; all estimates in panel B include an additional control for gender. Heteroskedasticity-adjusted robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively.
Use HRS and MCBS
MCBS contains detailed cost information
## TABLE 2

### ORDINARY LEAST SQUARES REGRESSION RESULTS OF TOTAL MEDICAL EXPENDITURE ON “MEDIGAP” COVERAGE IN THE MCBS

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>A. WITHOUT HEALTH CONTROLS</th>
<th>B. WITH DIRECT HEALTH CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (1)</td>
<td>Female (2)</td>
</tr>
<tr>
<td>Medigap</td>
<td>-4,392.7***</td>
<td>-6,037.4***</td>
</tr>
<tr>
<td></td>
<td>(346.5)</td>
<td>(455.5)</td>
</tr>
<tr>
<td>Female</td>
<td>270.0</td>
<td>. .</td>
</tr>
<tr>
<td></td>
<td>(356.2)</td>
<td></td>
</tr>
<tr>
<td>Age – 65</td>
<td>387.5***</td>
<td>460.6***</td>
</tr>
<tr>
<td></td>
<td>(138.0)</td>
<td>(175.5)</td>
</tr>
<tr>
<td>(Age – 65)²</td>
<td>1.9</td>
<td>-1.8</td>
</tr>
<tr>
<td></td>
<td>(10.6)</td>
<td>(13.2)</td>
</tr>
<tr>
<td>(Age – 65)³</td>
<td>.12</td>
<td>.17</td>
</tr>
<tr>
<td></td>
<td>(.22)</td>
<td>(.27)</td>
</tr>
<tr>
<td>State dummy</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(.22)</td>
<td>(.27)</td>
</tr>
<tr>
<td>Year dummy</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(.22)</td>
<td>(.27)</td>
</tr>
<tr>
<td>Observations</td>
<td>15,945</td>
<td>9,725</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>.073</td>
<td>.092</td>
</tr>
</tbody>
</table>

### B. WITH DIRECT HEALTH CONTROLS

|              | All (4)                  | Female (5)                     | Male (6)                      |
| Medigap      | 1,937.0***               | 1,677.3***                     | 2,420.9***                    |
|              | (257.2)                  | (348.0)                        | (395.8)                       |
| Female       | -751.6***                | . .                            | . .                           |
|              | (283.3)                  |                                |                               |
| Age – 65     | 394.5***                 | 417.5***                       | 355.4*                        |
|              | (117.2)                  | (144.6)                        | (196.8)                       |
| (Age – 65)² | -27.5***                 | -32.0***                       | -22.8                         |
|              | (9.2)                    | (11.4)                         | (16.2)                        |
| (Age – 65)³ | .47**                    | .55**                          | .47                           |
|              | (.21)                    | (.25)                          | (.38)                         |
| State dummy  | Yes                      | Yes                            | Yes                           |
| Year dummy   | Yes                      | Yes                            | Yes                           |
| Observations | 14,129                   | 8,371                          | 5,758                         |
| Adjusted $R^2$ | .211                     | .196                           | .252                          |

### NOTE

The dependent variable is total medical expenditure. All regressions are weighted by the cross-section sample weights. Health controls included in panel B are described in detail in the Data Appendix under the category Health. A total of 71 health indicators are included. Robust standard errors clustered at the individual level are in parentheses.

* Significant at 10 percent.
** Significant at 5 percent.
*** Significant at 1 percent.
Key concern: underwriting? Adverse selection vs. underwriting?
- Why advantageous selection on observables but adverse selection (or moral hazard) on unobservables?
  - Makes very little sense...
- Underwriting of firms?
- Later: role of crowd-out of uncompensated care for low-income populations
  - Depresses demand for low-income populations that have more medical expenditures
Estimating adverse selection using variation in prices

- Key problem with positive correlation test: can’t separate moral hazard vs. adverse selection
- Suppose there are two (fixed) insurance contracts:
  - High coverage ($H$) and low coverage ($L$)
- Agents choose $H$ or $L$
  - $P$ is relative price of $H$ versus $L$
  - $D(p)$ is the demand curve
    - Fraction of people who purchase $H$ instead of $L$
  - $AC(p)$ is the average cost curve
  - $MC(p)$ is the marginal cost curve
Key insight: can estimate demand and cost curves using random variation in prices

Demand is the % willing to pay a given price

Average cost is the cost experienced by the policy at different prices

Marginal cost is the derivative of average cost

- Measures how costs change in response to prices
- If average costs go up in response to price increases -> Adverse selection
  - Why not moral hazard?
Competitive Equilibrium with Adverse Selection


- Need random variation in prices
- Use data from Alcoa (they make aluminum)
  - Business unit heads choose price charged for high versus low coverage plans
Cost curve slopes downward
  - Suggests adverse selection

Next lecture: Welfare implications

Concerns:
  - If this was a big problem, can’t the firms simply price based on more observables?
Fun case of unraveling: health insurance at Harvard!
Harvard offers PPO and HMO
Traditionally, subsidizes the more expensive PPO plan
In 1995, switches to voucher system that provides equal payment to PPO and HMO
- Individuals bore full average cost of PPO relative to HMO
- Induced significant adverse selection
- PPO unraveled
General impression suggests adverse selection is not a big issue with insurance markets
  - Adverse selection tends to occur when can’t price based on observables
But, is adverse selection the right thing to look for?
  - Akerlof (1970) suggests private info can completely unravel the market
  - Would not observe positive correlation between insurance purchase and claims if people with private information aren’t offered any contracts
Recent work suggests private information prevents the existence of insurance markets
  - Rejections for those with pre-existing conditions in LTC, Life, and Disability Insurance (Hendren, 2013)
  - Private market for unemployment insurance (Hendren, 2016)
Hendren (2013) characterizes when private information leads to adverse selection

\[ \frac{u'(w - l)}{u'(w)} \leq \inf_p T(p) \]

where

\[ T(p) = \frac{E[P|P \geq p]}{1 - E[P|P \geq p]} \frac{1 - p}{p} \]

Depends on two numbers:
- Markup people are willing to pay for insurance, \( \frac{u'(w - l)}{u'(w)} \)
- Smallest markup imposed by worse risks adversely selecting the insurance contract
  - “Pooled price ratio”, \( T(p) \)
Insurance Rejections

1 in 7 applicants rejected in individual health insurance
Rejections common in individual life, LTC, disability insurance too
Lots of policy interest...
  - Even Romney wanted to ban rejections for pre-existing conditions
Idea: Rejections are market segments (defined by observable characteristics) for which private information has led to market unraveling
UNINSURABLE CONDITIONS
Acquired Immune Deficiency Syndrome (AIDS)
ADL limitation, present
AIDS Related Complex (ARC)
Alzheimer's Disease
Amputation due to disease, e.g., diabetes or atherosclerosis
Amyotrophic Lateral Sclerosis (ALS), Lou Gehrig's Disease
Ascites present
Ataxia, Cerebellar
Autonomic Insufficiency (Shy-Drager Syndrome)
Autonomic Neuropathy (excluding impotence)
Behçet's Disease
Binswanger's Disease
Bladder incontinence requiring assistance
Blindness due to disease or with ADL/IADL limitations
Bowel incontinence requiring assistance
Buergers Disease (thromboangiitis obliterans)
Cerebral Vascular Accident (CVA)
Chorea
Chronic Memory Loss
Cognitive Testing, failed
Cystic Fibrosis
Dementia
Diabetes treated with insulin
Dialysis, Kidney (Renal)
Ehlers-Danlos Syndrome
Forgetfulness (frequent or persistent)
Gangrene due to diabetes or peripheral vascular disease
Hemiplegia
Hoyer Lift
Huntington's or other forms of Chorea
Immune Deficiency Syndrome
Korsakoff's Psychosis
Leukemia-except for Chronic Lymphocytic Leukemia (CLL) and Hairy Cell Leukemia (HCL)
Marfan's Syndrome
Medications
Antabuse (disulfiram)
Aripiprazole (Abilify)
Campral (acamprosate calcium)
Cogentin (ticamole)
Depade (naloxone)
Exelon (rivastigmine)
Hydergine (ergoloid mesylate)
Namenda (memantine)
Razzodyne (galantamine hydrobromide)
Rimulti (galantamine hydrobromide)
Riviva (naloxone)
Viactiv (naloxone)
Memory Loss, chronic
Mesothelioma
Multiple Sclerosis (MS)
Does private information cause rejections?

Need to estimate private information for rejectees and non-rejectees.

- Positive correlation test fails
- Difficult to estimate demand curves for contracts that don’t exist

Solution: Use subjective probability elicitation in the Health and Retirement Study

“What’s the chance (0-100%) that you will go to a nursing home in the next 5 years?”
Elicitation Error

- Do people report their true beliefs?
  - Hendren (2013) argues probably not
    - See Manski (ECMA 2004) for a rosier assessment
    - Evidence from psychology shows question framing affects response

- Zero is pretty optimistic for 75 year olds...
Hendren (2013) imposes increasing sets of assumptions

- Minimal assumptions allow for testing for presence of private information
- Stronger assumptions allow for quantification of price of market existence

General tradeoff between quality of question vs. quality of assumptions
Assumptions on Beliefs (I)

- General idea: Agents behave as if they have beliefs $P$ about the loss $L$, but may not be able to express these beliefs on surveys
  - Savage (1954) axioms; see Blackwell (1951, 1953) for sufficient statistics work too...

- **Assumption 1:** Elicitations contain no more information about $L$ than do true beliefs
  - If $Z$ contains information about $L$ conditional on $X$, then so does $P$.
  - “$P$ is sufficient statistic for $Z$ about $L$”.

- **Test for Private Information:** Is $Z$ predictive of $L$, conditional on $X$?

- Context: Tests for private information in hypothetical insurance market that pays $1$ in the event $L$ occurs.
<table>
<thead>
<tr>
<th></th>
<th>LTC</th>
<th>Disability</th>
<th>Life</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reject</strong> p-value²</td>
<td>0.0358***</td>
<td>0.0512***</td>
<td>0.0587***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td><strong>No Reject</strong> p-value²</td>
<td>0.0049</td>
<td>0.0240</td>
<td>0.0249</td>
</tr>
<tr>
<td></td>
<td>(0.336)</td>
<td>(0.853)</td>
<td>(0.119)</td>
</tr>
<tr>
<td><strong>Difference: Δₜ</strong> p-value³</td>
<td>0.0309***</td>
<td>0.0272</td>
<td>0.0338***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.121)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Uncertain, E[mₜ(Pₜ)] (p-value)</td>
<td>0.0086***</td>
<td>0.0409***</td>
<td>0.0294***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Age Results

Magnitude of Private Info (Lower Bound)

LTC

No Rejection Conditions (excl Age) 2.5/97.5
Rejection Conditions 2.5/97.5

Not Rejected Based On Age
Rejected Based On Age

Nathaniel Hendren (Harvard)
Adverse Selection
Spring, 2020 65 / 88
Evidence of private information
  - Is it sufficient to explain absence of trade for the rejected?
  - Small enough to explain presence of trade for those not rejected

Need additional assumptions...
  - Unbiased beliefs
  - Model of the elicitation error
## Price of Market Existence

### Tax Rate Equivalence: $\inf T(p) - 1$

<table>
<thead>
<tr>
<th></th>
<th>LTC</th>
<th>Disability</th>
<th>Life</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reject</strong></td>
<td>0.827**</td>
<td>0.661**</td>
<td>0.428**</td>
</tr>
<tr>
<td>5%</td>
<td>0.657</td>
<td>0.524</td>
<td>0.076</td>
</tr>
<tr>
<td>95%</td>
<td>1.047</td>
<td>0.824</td>
<td>0.780</td>
</tr>
<tr>
<td><strong>No Reject</strong></td>
<td>0.163</td>
<td>0.069</td>
<td>0.350</td>
</tr>
<tr>
<td>5%</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>95%</td>
<td>0.361</td>
<td>0.840</td>
<td>0.702</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>0.664**</td>
<td>0.592**</td>
<td>0.077</td>
</tr>
<tr>
<td>5%</td>
<td>0.428</td>
<td>0.177</td>
<td>-0.329</td>
</tr>
<tr>
<td>95%</td>
<td>0.901</td>
<td>1.008</td>
<td>0.535</td>
</tr>
</tbody>
</table>
What is a plausible willingness to pay?

- Existing estimates/calibrations of $\frac{u'(w-l)}{u'(w)}$:
  - LTC: 26-62% (Brown and Finkelstein, 2008)
  - Disability: 46-109% (Bound et al., 2004)

- Direct Calibration: Assume $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ and $l = \gamma w$

  - If $\gamma = 10\%$ and $\sigma = 3$, then $\frac{u'(w-l)}{u'(w)} - 1 = 0.372$
Existing literature has conducted versions of the positive correlation test in LTC and Life

- **Finkelstein and McGarry (AER 2006)** find no evidence of adverse selection in LTC
  - But were first to use subj prob to show people know about their future nursing home use
  - Suggest inversely correlated unobserved preference heterogeneity as explanation for why private info does not manifest in adverse selection (see also Cutler et al 2008 AER P&P, Fang et al (2008))

- **Cawley and Philipson (JPE 1999)** find no evidence of adverse selection in Life
  - Suggest insurance company knows more than applicants
  - He (2008 JPubEc) revisits Life and finds some evidence of adverse selection

Results suggest practice of rejections limits the extent of adverse selection in these markets

- Positive correlation test only tests for adverse selection, not private information
Evidence private information shuts down segments of health-related insurance markets

- What about other settings?

Job loss is one of most salient risks faced by working-age adults

Why is there not a robust private market for unemployment/job loss insurance?

Hendren (2016): Private information is the reason the private market doesn’t exist

- If a third-party insurer were to try to sell a UI policy, it would be too heavily adversely selected to deliver a positive profit – at any price
Document 3 pieces of evidence:

1. Subjective probability elicitation
2. Spousal labor supply responses
3. Consumption responses
Use data from Health and Retirement Study (1993-2013)
- Survey asks subjective probability elicitations, $Z$
  - "What is percent chance (0-100) that you will lose your job in the next 12 months?"
- Do the elicitations predict future job loss conditional on observables?
## Regression of Job Loss on Elicitation

<table>
<thead>
<tr>
<th>Specification</th>
<th>Baseline</th>
<th>Demo Only</th>
<th>Demo, Job, Health</th>
<th>Ind FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elicitation</td>
<td>0.0836***</td>
<td>0.0956***</td>
<td>0.0822***</td>
<td>0.0715***</td>
</tr>
<tr>
<td>s.e.</td>
<td>(0.00675)</td>
<td>(0.00685)</td>
<td>(0.00736)</td>
<td>(0.0107)</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Dummies</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Job Characteristics</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Health Characteristics</td>
<td>X</td>
<td></td>
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<tr>
<td>Individual FE</td>
<td></td>
<td></td>
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<td>X</td>
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<tr>
<td>Num of Obs.</td>
<td>26640</td>
<td>26640</td>
<td>22831</td>
<td>26640</td>
</tr>
<tr>
<td>Num of HHs</td>
<td>3467</td>
<td>3467</td>
<td>3180</td>
<td>3467</td>
</tr>
</tbody>
</table>
Large literature on “added worker” effect studies impact of unemployment on spousal labor supply

- If individuals learn ex-ante about future job loss, then should expect spouses to respond when individuals learn

Focus on labor market entry for sample of married households in HRS

- Define an indicator for a spouse not in labor force last period and in labor force this period
Spousal Labor Supply Response

<table>
<thead>
<tr>
<th>Specification:</th>
<th>Baseline</th>
<th>HH FE</th>
<th>Ind FE</th>
<th>2yr Lagged Entry (&quot;Placebo&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Estimation of dL/dZ</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elicitation (Z)</td>
<td>0.0258***</td>
<td>0.0243**</td>
<td>0.0312*</td>
<td>0.00122</td>
</tr>
<tr>
<td>s.e.</td>
<td>(0.00868)</td>
<td>(0.0114)</td>
<td>(0.0180)</td>
<td>(0.00800)</td>
</tr>
<tr>
<td>Mean Dep Var</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.0394</td>
</tr>
<tr>
<td>Num of Obs.</td>
<td>11049</td>
<td>11049</td>
<td>11049</td>
<td>11049</td>
</tr>
<tr>
<td>Num of HHs</td>
<td>2214</td>
<td>2214</td>
<td>2214</td>
<td>2214</td>
</tr>
</tbody>
</table>
Large literature documenting unemployment/job loss impact on consumption
- Common to study impact of unemployment on 1-year consumption growth
- If individuals learn ex-ante, consumption might respond

Use food expenditure in PSID
- Following Gruber (1997)

Event study using leads/lags:
- Regress $g_t = \log(c_t) - \log(c_{t-1})$ on $U_{t+j}$
  - Control for age cubic and year dummies
- Restrict to sample employed in $t-2$ and $t-1$
Impact of Unemployment on Consumption Growth

Employed in t-2 and t-1 Sample

![Graph showing the impact of unemployment on consumption growth with coefficient values and 5%/95% CI intervals.]
## Impact of Future Job Loss on Consumption

**Specification:**

<table>
<thead>
<tr>
<th></th>
<th>Unemployment</th>
<th>Income Controls</th>
<th>Involuntary Job Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact of Unemployment on log(c_{t-2})-log(c_{t-1})</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemp</td>
<td>-0.0271***</td>
<td>-0.0272***</td>
<td>-0.0260***</td>
</tr>
<tr>
<td>s.e.</td>
<td>(0.00975)</td>
<td>(0.00969)</td>
<td>(0.00824)</td>
</tr>
<tr>
<td><strong>Num of Obs.</strong></td>
<td>65483</td>
<td>65399</td>
<td>65556</td>
</tr>
<tr>
<td><strong>Num of HHs</strong></td>
<td>9557</td>
<td>9547</td>
<td>9560</td>
</tr>
</tbody>
</table>
Implications:

- People have private information about future job loss
- They act upon this information $\rightarrow$ private policies would be adversely selected...
- *Can this explain the absence of a private market?*
## Minimum Pooled Price Ratio

<table>
<thead>
<tr>
<th>Specification</th>
<th>Baseline (1)</th>
<th>Alternative Controls</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inf $T(p) - 1$</td>
<td>3.360</td>
<td>5.301</td>
<td>3.228</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s.e.</td>
<td>(0.203)</td>
<td>(0.655)</td>
<td>(0.268)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job Characteristics</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Characteristics</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Num of Obs.</td>
<td>26,640</td>
<td>26,640</td>
<td>22,831</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num of HHs</td>
<td>3,467</td>
<td>3,467</td>
<td>3,180</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Minimum Pooled Price Ratio

<table>
<thead>
<tr>
<th>Specification</th>
<th>Sub-Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age &lt;= 55</td>
</tr>
<tr>
<td>Inf T(p) - 1</td>
<td>3.325</td>
</tr>
<tr>
<td>s.e.</td>
<td>(0.306)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>X</td>
</tr>
<tr>
<td>Job Characteristics</td>
<td>X</td>
</tr>
</tbody>
</table>

| Num of Obs.            | 11,134       | 15,506     | 13,320             | 13,320             | 17,850        | 8,790          |
| Num of HHs             | 2,255        | 3,231      | 2,916              | 2,259              | 2,952         | 2,437          |
Hendren (2017) also estimates WTP – will discuss next class.

Private information provides micro-foundation for absence of market:

\[
\text{WTP} \leq \text{Pooled Price Ratio} \\
[15\%, 60\%] \leq 300\%
\]

Private information explains absence of private UI market

Growing evidence that private information shapes the existence of insurance markets
Comparison of $\inf T(p)$ to Other Markets
Life, Disability, and LTC Estimates from Hendren (2013)
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Markets Exclude “Pre-existing Conditions”

No Market Exists
Market Exists

Life
Disability
LTC
Unemployment

$\inf(T(p)) - 1$
Why No Rejections in Annuities?

- Does private information always lead to rejection? No!
- Robust evidence of private information in annuity markets
  - Those who purchase annuities have longer life expectancy
- Why does life insurance have rejections but annuities have a thriving market with adverse selection?
  - Shape of incentive constraints:
    - Only one way to be healthy but many ways to be sick (Hendren, 2013)
    - Can sell annuities to the healthy without even healthier risks adversely selecting the annuity
    - But the sick don’t get discounts!
- Akerlof unraveling does not occur
  - Rothschild and Stiglitz intuition: Can insure the “worst risk” type of healthy people
Private information / adverse selection forms the boundary to the existence of insurance markets
  Makes testing for observed adverse selection hard
Existing evidence of “advantageous selection” in insurance are problematic
  Likely reflects underwriting of firms, not selection of individuals
    It’s not that the sick don’t want insurance, but rather the firms don’t want the sick
Open questions about how best to model insurance markets
  In particular, how does contract design respond to asymmetric information?