Why Insurance Works Better With Some Adverse Selection

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About the speaker

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  - Fellow of the Institute and Faculty of Actuaries
  - Fellow of the Institute of Actuaries of India
  - Research Interests:
    - Loss coverage and public policy aspects of risk classification
    - Economic capital and financial risk management of financial services firms

- University of Kent
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Agenda

- Background
- Motivating Examples
- Insurance Market Model
- Iso-elastic Demand
- Summary
Background
Background

- Usual adverse selection argument: Pooling of risks implies
  - higher risks buy more insurance
  - lower risks buy less insurance
  - *raising pooled price* of insurance
  - *lowering demand* for insurance.

- Usually portrayed as a bad outcome!
  - Both for insurers and for society.
Background

- In practice:
  - EU ban on using gender in insurance underwriting
  - Moratoria on the use of genetic test results in underwriting

- We argue that pooling implies:
  - A shift in coverage towards higher risks
  - Loss coverage can increase
  - Good outcome from adverse selection!
Motivating Examples
Motivating Example 1

1. No adverse selection

Risk-differentiated premiums = 0.01

Weighted average premium

Loss coverage

Risk-differentiated premiums = 0.04

\[
\begin{align*}
(4 \times 0.01 + 1 \times 0.04) \\
5
\end{align*}
\]

\[
\begin{align*}
(4 \times 0.01 + 1 \times 0.04) \\
8 \times 0.01 + 2 \times 0.04
\end{align*}
\]

0.016

50%
Motivating Example 2

2. Some adverse selection

Pooled premiums = 0.03

Weighted average premium

Loss coverage

\[
(1 \times 0.01 + 2 \times 0.04) / 3
\]

\[
(1 \times 0.01 + 2 \times 0.04) / (8 \times 0.01 + 2 \times 0.04)
\]

0.03

56%
Motivating Example 3

3. Severe adverse selection

Pooled premiums = 0.04

Weighted average premium

Loss coverage

$$\frac{(1 \times 0.04)}{8 \times 0.01 + 2 \times 0.04}$$
Insurance Market Model
Insurance Demand

- Consider individuals in a particular risk-group
  - with probability of loss $\mu$;
  - offered insurance at premium rate $\pi$.
  - proportional demand for insurance: $d(\mu, \pi)$

- Consider $n$ risk-groups where for each risk-group $i = 1, 2, \ldots, n$:
  - population proportion: $p_i$
  - insurance demand: $d(\mu_i, \pi_i)$
Insurance Market and Equilibrium

- $Q$ : Indicator of insurance purchase (1=purchase, 0 otherwise)
- $L$ : Indicator of loss event (1=loss occurs, 0 otherwise)
- $\Pi$ : Premium offered ($\pi_i$ = premiums on purchase, 0 otherwise)

- Expected premium income: $E[Q\Pi]$
- Expected insurance claim: $E(QL)$

- Market equilibrium: $E[Q\Pi] = E(QL)$
Loss Coverage

At market equilibrium **loss coverage** is defined as:

\[ E[QL] \]

Note: \( QL = 1 \) if an individual both incurs a loss and has cover.

**Loss coverage ratio** is defined as:

\[ C = \frac{E[QL]}{E_0[QL]} \]

where \( E_0[QL] \) is the loss coverage under full risk-differentiation.
Iso-elastic Demand
Iso-elastic Demand

- Iso-elastic demand: 
  \[ d(\mu_i, \pi_i) = \tau_i \left( \frac{\mu_i}{\pi_i} \right)^{\lambda_i} \]

- Fair-premium demand: 
  \[ d(\mu_i, \mu_i) = \tau_i \]

- Constant demand elasticity: 
  \[ \left| \frac{\partial \log[d(\mu_i,\pi_i)]}{\partial \log \pi_i} \right| = \lambda_i \]
Same Constant Demand Elasticity: $\lambda$

- Pooled equilibrium premium: $\pi_1 = \pi_2 = \cdots = \pi_n = \pi_0$.

$$\pi_0 = \frac{\sum_{i=1}^{n} \alpha_i \mu_i^{\lambda+1}}{\sum_{i=1}^{n} \alpha_i \mu_i^{\lambda}}$$

- Loss coverage ratio:

$$C = \frac{1}{\pi_0^{\lambda}} \frac{\sum_{i=1}^{n} \alpha_i \mu_i^{\lambda+1}}{\sum_{i=1}^{n} \alpha_i \mu_i^{\lambda}}$$

where $\alpha_i$ is the fair-premium demand share for risk-group $i$. 
Same Constant Demand Elasticity: $\lambda$

Result 1: $\lambda \leq 1 \Rightarrow C \geq 1$
Different Constant Demand Elasticities: $\lambda_1, \lambda_2$

Result 2: $\lambda_1 \leq 1$ and $\lambda_2 \geq \lambda_1 \Rightarrow C \geq 1$
## Empirical Evidence on Demand Elasticities

<table>
<thead>
<tr>
<th>Market and country</th>
<th>Estimated Demand Elasticities</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly renewable term life insurance, USA</td>
<td>0.4 to 0.5</td>
<td>Pauly et al (2003)</td>
</tr>
<tr>
<td>Term life insurance, USA</td>
<td>0.66</td>
<td>Viswanathan et al (2007)</td>
</tr>
<tr>
<td>Whole life insurance, USA</td>
<td>0.71 to 0.92</td>
<td>Babbel (1985)</td>
</tr>
<tr>
<td>Health insurance, USA</td>
<td>0 to 0.2</td>
<td>Chernew et al (1997), Blumberg et al (2001), Buchmueller and Ohri (2006)</td>
</tr>
<tr>
<td>Health insurance, Australia</td>
<td>0.35 to 0.50</td>
<td>Butler (1999)</td>
</tr>
<tr>
<td>Farm crop insurance, USA</td>
<td>0.32 to 0.73</td>
<td>Goodwin (1993)</td>
</tr>
</tbody>
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Insurance demand elasticity $\lambda < 1$ has been observed in a number of studies.
Summary
Summary

- Pooling increases loss coverage if $\lambda < 1$.

- From a social policy perspective, a shift in coverage towards higher risks by pooling can sometimes more than offset the fall in numbers insured.

- Adverse selection need not always be adverse!
http://blogs.kent.ac.uk/loss-coverage/
Thank you very much for your attention!

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