The Shifting Shape of Risk: Endogenous Market Failure for Insurance

Thomas G. Koch

June 2008
Two Trends

- Medical Insurance has become more expensive
- Price increases: 5-6% per year
Two Trends

- Medical Insurance has become more expensive
- Price increases: 5-6% per year
- Fewer people have it
- 1996: over 81%
- 2004: under 79%
Objectives

- Posit a model of endogenous uninsurance
- Asymmetric information and Adverse Selection with Price Competition
- Changes in uninsurance due to changes in distribution of risk
Results

- Symmetric changes (e.g., price of care) dominate predicted rates of uninsurance
- Asymmetric changes (e.g., new treatments) have small effects
Aggregating Risk

For an agent of type $\lambda_i \in \Lambda$

$$Pr(mx_i < X|\lambda_i)$$
The unconditional distribution of realized risk is then

\[ Pr(mx_i < X) = \int \Pr(mx_i < X | \lambda_i) dG(\lambda_i) \]
Distribution, $G$, of risk types matters

- If asymmetric information . . .
- How much risk sharing across types
Type $\lambda_i \in \Lambda$ facing exponentially distributed risk

$$Pr(mx_i < X|\lambda_i) = 1 - e^{-\lambda_i X}$$
Specifying Risk

Type \( \lambda_i \in \Lambda \) facing exponentially distributed risk

\[
Pr(mx_i < X | \lambda_i) = 1 - e^{-\lambda_i X}
\]

Types distributed Gamma\((\alpha, \beta)\)

\[
Pr(mx_i < X) = \int_{\Lambda} \left(1 - e^{\lambda X}\right) \frac{\lambda^\alpha e^{-\lambda/\beta}}{\beta^{\alpha+1} \Gamma(\alpha + 1)} d\lambda
\]
Specifying Risk

Type $\lambda_i \in \Lambda$ facing exponentially distributed risk

$$Pr(mx_i < X|\lambda_i) = 1 - e^{-\lambda_i X}$$

Types distributed $\text{Gamma}(\alpha, \beta)$

$$Pr(mx_i < X) = \int_{\Lambda} (1 - e^{\lambda X}) \frac{\lambda^\alpha e^{-\lambda/\beta}}{\beta^{\alpha+1} \Gamma(\alpha + 1)} d\lambda$$

... the unconditional distribution of realized risk is

$$Pr(mx_i < X) = 1 - \frac{1}{(\beta X + 1)^{\alpha+1}}$$
Density of Medical Charges

Data
Density
Empirical PDF
Gamma–mix Pareto Fit
The Shifting Shape of Risk?

- Look at cross-sectional medical distribution across years
- Get implied series of $\{\alpha_t, \beta_t\}$
- How much risk sharing across types if asymmetric information?
Interpreting the Gamma Distribution

$\beta$, scale parameter

- Decrease $\beta \Rightarrow$ All risk grows same amount
- E.g., a change in price of medical care
Interpreting the Gamma Distribution

\[ \beta, \text{ scale parameter} \]

- Decrease \( \beta \) \( \Rightarrow \) All risk grows same amount
- E.g., a change in price of medical care

\[ \alpha, \text{ shape parameter} \]

- Decrease \( \alpha \) \( \Rightarrow \) Increase skewness, kurtosis
- Asymmetric changes (obesity, disease incidence, disease cost)
Model

- CARA Preferences
- Asymmetric information
- Competitive insurance markets
Model

- CARA Preferences
- Asymmetric information
- Competitive insurance markets
- Multiple equilibria
- Get predicted insurance price, rate
One stable equilibrium

Stability of two equilibria: $\alpha=1.05 \ \beta=.003 \ \gamma=0.01 \ \kappa=50,000$

$\pi(\lambda; \kappa)$
$\varpi(\lambda)$
Data

- 1996-2004 MEPS
- Non-elderly, non-poor, non-military
- Total charges vs. Private insurance spending
Insurance rate trends, using private medical insurance expenditure

Year | Insurance rate
---|---
1996 | 0.78
1997 | 0.8
1998 | 0.82
1999 | 0.84
2000 | 0.86
2001 | 0.88
2002 | 0.9
2003 | 0.88
2004 | 0.86

**Predicted vs. Actual Insurance Rate**
Changes in $\beta$ Dominate

Insurance rate trends, using private medical insurance expenditure

- **Fit**
- **Constant $\alpha$**
- **Constant $\beta$**

Year | Insurance rate
--- | ---
1996 | 0.78
1997 | 0.80
1998 | 0.82
1999 | 0.84
2000 | 0.86
2001 | 0.88
2002 | 0.90
2003 | 0.88
2004 | 0.87

Thomas G. Koch

Shape of Risk
Swartz (2006)

1. Increasing cost of care $\Rightarrow$ Increasing price of insurance
2. Increasing price of insurance $\Rightarrow$ Decreasing insurance rate
Swartz (2006)

1. Increasing cost of care ⇒ Increasing price of insurance
2. Increasing price of insurance ⇒ Decreasing insurance rate

The glass is half full

1. Common increases in medical risk
Swartz (2006)

1. Increasing cost of care $\Rightarrow$ Increasing price of insurance
2. Increasing price of insurance $\Rightarrow$ Decreasing insurance rate

The glass is half full

1. Common increases in medical risk
2. Should have induced more insurance