Optimal Health Insurance for Prevention and Treatment

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Rich literature on optimal health insurance

Zeckhauser JET (1970) is classic article describing tradeoff between risk spreading and moral hazard

Conventional approach emphasizes:

- Demand responsiveness
- Variance in health care spending
- Degree of risk aversion
- Insurance loading factor

Focus of paper is on demand side incentives, ignoring supply-side moral hazard and supply-side cost sharing

New questions answered in this paper

How should optimal insurance coverage be modified in the presence of

- Preventive care services?
- Multiple health care goods with correlated errors?
- Cross price elasticities of demand?
- Uncompensated losses that are correlated with health spending?
- Multiple time periods when health care spending is serially correlated over time?

Summary of what paper shows

1. Preventive care should be covered generously because consumers will ignore premium savings in their private prevention decisions.
2. Health care goods that are positively correlated with other health spending should be more generously covered
3. Health care goods that are substitutes should be covered more generously than complements.
4. Cover services generously that are positively correlated with uncompensated losses
5. Services that are positively serially correlated over time should be covered more generously than those that are uncorrelated

Optimal insurance coverage for preventive care has received relatively little attention

- Low variance suggests insurance not needed (Kenkel, AEA presentation 2007)
- Demand elasticity low relative to curative care (uncertain)?
- Insurance reduces value of prevention
- Primary versus secondary prevention
- Boundary between prevention and treatment is sometimes blurry (e.g. drugs, preventive treatment)
- We define prevention activities as costly services to the consumer that reduce the probability of being sick.

Five types of losses modeled

Ex ante moral hazard loss from too little prevention

Ex post moral hazard loss from overinsurance

Inefficiency due to insurance loading factors

Arrow-Pratt cost of risk

Uncompensated losses due to ill health

Organization of paper

Literature review

Basic model – use consumer surplus measure

- no prevention, homoscedastic error

Utility-based models

- Prevention + one health treatment good
- Key role of uncompensated health losses
- Multiple health treatment goods
- Multiple periods

Discussion and empirical relevance

Huge literature potentially related to these questions – Most of Audience in this room!

Optimal deductibles and copayments

Demand responsiveness of specific services

Optimal insurance with multiple goods

Dynamic models of health spending

Prevention

Statistical models of the distribution of health care costs over time

Literature is ambiguous on insurance coverage for preventive care

Low variance suggests insurance not needed (Kenkel, AEA presentation 2007)

Demand elasticity low relative to curative care (uncertain)?

Insurance reduces value of prevention (*ex ante* moral hazard)

Primary versus secondary prevention

Boundary between prevention and treatment is sometimes blurry (e.g. drugs, preventive treatment)

We define prevention activities as costly activities to the consumer that reduce the probability of being sick.

Table 1. Notation

Z = quantity of preventive care

X = quantity of health care treatment (eventually a vector, X = $\{X_i\}$)

Y = quantity of all other consumption goods

P_X, P_Y, P_Z = Demand prices of X, Y, and Z

α(Z) = probability of being perfectly healthy

c_X, c_Z, c_i = coinsurance rates on X, Z, or service i (share of costs paid by consu

μ_X = mean of health care spending

B = slope of demand curves of the form X = μ_X - B c + θ

δ = insurance loading factor

θ = random shock(s) affecting health and demand for X (eventually a vector of th

$\sigma_X^2 = \sigma_\theta^2$ = variance of health care spending

R^A = absolute risk aversion constant= -V_{II}/V_i

V = the consumer's utility function

π = premium paid by consumer

P_Z = price of preventive care

r = consumer discount rate

L = uncompensated loss from illness = L(θ)

γ = power with which variance of spending increases with mean health spending

Basic model

One health care good X

Linear demand curve when sick of $X = \mu_X - B\, P_X + \theta$

Θ = random shock affecting demand for X (also health status shock)

Marginal cost = 1

$P_X = c_X$ = cost share of health care treatment

Adding in insurance and cost of risk

Use Arrow-Pratt approximation for welfare loss from financial risk

Cost of risk = (R^A)(variance of out-of-pocket spending)/2

Assume probability of sickness = $1 - \alpha(Z)$

Health spending only if sick

Insurance loading factor δ implies extra cost of using insurance funding is

$= \delta\,(1-\alpha(Z))\,(1-c_X)\,(\mu_X - B\,c_X)$

Uncompensated loss from insurance = L

Four terms in loss function to be minimized

Ex post moral hazard loss from overinsurance = $(1/2)(1-c_X)^2 B$

Inefficiency due to insurance loading factors = $\delta\left[(1-c_X)(\mu_X - Bc_X)\right]$

Arrow-Pratt cost of risk = $\left[R^A c_X{}^2 \sigma_\theta{}^2 / 2\right]$

Uncompensated losses due to ill health = $L(\theta)$, with expectation L

$$WL^1 = (1/2)(1-c_X)^2 B + \delta(1-c_X)(\mu_X - Bc_X) + R^A c_X{}^2 \sigma_\theta{}^2 / 2 + L$$

$$c_X^* = \frac{B + B\delta + \mu_X \delta}{B + 2B\delta + R^A \sigma_\theta{}^2}$$

Table 2. Comparative statics on optimal c_X^* using the basic model

Effect of:		on c_X^*
Demand slope	$\lvert B \rvert$	+
Mean spending	μ_X	+
Risk aversion parameter	R^A	–
Variance of spending	$\sigma_\theta{}^2$	–
Insurance loading cost	δ	+

Results are interesting and plausible and many parameters can be calculated empirically

BUT

Does not suggest how to incorporate multiple goods

Does not expand to multiple periods well

Does not incorporate risk aversion in a fully satisfying way

Only approximates a utility maximization framework

Utility-based model

Three kinds of goods

X = health care goods indexed by

Y = all other consumption goods

Z = spending on preventive care

P_X, P_Y, P_Z = prices of three types of goods

π = insurance premium

I = Income

$I = \pi + P_X X + P_Y Y + P_Z Z$

Sequence of moves

1. The insurer chooses coinsurance rates c_X and c_Z for treatment and prevention.
2. The consumer chooses Z to maximize ex ante utility in Period 1 by borrowing its cost against Period 1 income.
3. Nature decides on the consumer's state of illness θ
4. The consumer chooses X and Y
5. If a dynamic model, then repeat steps 3 and 4 (prevention is done one time in Period 0).

Expected utility framework used

$E\ U = E_\theta\ U(Y, H(X, \theta))$

Three key assumptions about utility function

1. $U_{YH} < 0$

Favorable health care shocks reduce the marginal utility of income

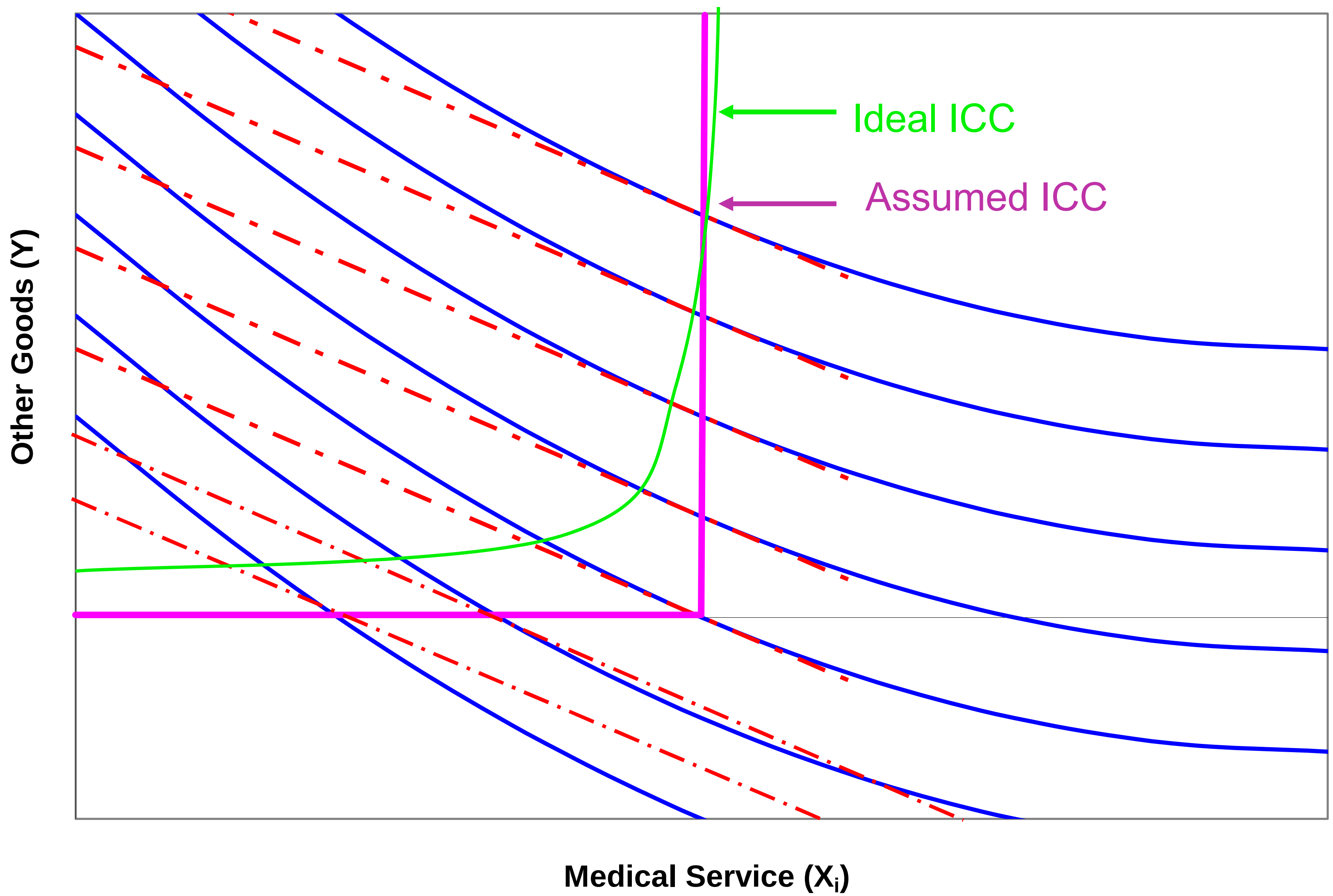
2. $\partial X/\partial I = 0$

    Zero income effects, so Consumer Surplus = Compensating Variation for health goods

3. Linear demand curves for X

    $X = \mu_X - B\ P_X + \theta$

Assumed Effect of Income Changes on Optimal Consumption Bundles



Demand for each health service X when sick:

$$X = A - B\frac{P_X}{P_y}$$

Use Roy's identity to derive

risk neutral utility function when sick

$$\tilde{V}^S(I,\ P) = \frac{I}{P_Y} - A\frac{P_X}{P_Y} + B\frac{{P_X}^2}{{P_Y}^2}$$

Introduce stochastic element to demand

$A = \mu_X + \theta$ where $\theta \sim F(\theta)$ with $E(\theta) = 0$

Full model with prevention

Health shocks theta also affect uncompensated losses of two types: monetary and health

Prevention increases probability of being healthy

Health shocks theta affect out-of-pocket costs

$$EV = \alpha(Z)\, V^{H}(J) + (1-\alpha(Z)) \left\{ E_{\theta}\left[V^{S}\left(J - K - (c_X + L^1)\theta\right) - L^2(\theta) \right] \right\}$$

where

$$J = I - \pi - c_Z Z$$

Prevention costs can either be paid out of pocket or covered by insurance

$$K = c_X \mu_X - \frac{B(c_X + L^1)^2}{2}, \text{ and}$$

Benefits of health treatment are quadratic in prices, c_X ,+L^1

$$\pi = (1+\delta)\left[(1-\alpha(Z))(1-c_X)(\mu_X - B c_X) + (1-c_Z) Z\right]$$

Insurance loading factor increases premium by proportion delta

Prevention reduces treatment costs covered by premium

Socially optimal choice of preventive care Z^{SOC} differs from private choice Z^{PRIV} in that private choice ignores change in premium

Compare Z^{SOC} and Z^{PRIV}

$$\frac{\alpha'(Z^{\mathrm{SOC}})}{E\left[V_I\right]} = \frac{\left[\dfrac{\partial \pi}{\partial Z} + MC_Z\right]}{\left[V^H - E\left[V^S\right]\right]}, \quad \frac{\alpha'(Z^{PRIV})}{E\left[V_I\right]} = \frac{P_Z}{\left[V^H - E\left[V^S\right]\right]}$$

$$\begin{cases} Z^{\mathrm{SOC}} > Z^{\mathrm{PRIV}} \text{ if } \alpha''(\cdot) < 0 \\ \text{Private choice results in too little prevention when } \mathrm{P_Z} = \mathrm{MC_Z} \\ \text{Therefore prevention services should be subsidized} \end{cases}$$

Optimal cost sharing on preventive care

$$c_z^* = \frac{P_Z}{MC_Z} = \frac{Q}{Q + (1 - c_X)(\mu_X - Bc_X)} < 1$$

where

$$Q = \left[V^H - E\left[V^S\right]\right] \big/ E\left[V_I\right]$$

Model with multiple goods and no prevention

Demand curves for two health treatment goods

$$X_1 = \mu_1 - B_1 c_1 + G_{12} c_2 + \theta_1$$
$$X_2 = \mu_2 - B_2 c_2 + G_{12} c_1 + \theta_2$$

Optimal cost share
One health treatment good, no insurance loading

$$c_1^* = \frac{B_1}{B_1 + R^A \sigma_1^2}$$

C_1^* increases with B_1 and decreases with R^A, σ_1^2

Confirms conventional results

Optimal cost share
One health treatment good,
Insurance loading factor $\delta > 0$)

$$c_1^* = \frac{B_1 + B_1\delta + \delta\mu_1}{B_1 + 2\delta B_1 + R^A \sigma_1^2}$$

C_1^* increases with δ and μ_1

Optimal cost share
One health treatment good
Uncompensated losses from health shocks

$$EV^S = E_\theta\left[V^S\left(I - \pi - c_1\mu_1 + \frac{B_1 c_1{}^2}{2} - c_1\theta - L^1\theta \right)\right]$$

$$c_1^* = \frac{B_1 - R^A\sigma_1^2 L_1^1}{B_1 + R^A\sigma_1^2}$$

c_1* decreases with uncompensated losses and can be zero or negative at optimum

Optimal cost share
Two health treatment goods
Correlated health shocks and nonzero cross price elasticities

$$c_1^* = \frac{(G_{12} - B_2)(R^A\sigma_{12} - G_{12}) - (G_{12} - B_1)(R^A\sigma_2^2 + B_2)}{(R^A\sigma_1^2 + B_1)(R^A\sigma_2^2 + B_2) - (R^A\sigma_{12} - G_{12})^2}$$

- As limiting case, c_1* should be lower for services with positively correlated health shocks
- As limiting case, c_1* should be higher for complements than substitutes

Two period model

ρ = health shock serial correlation

φ =discount factor

$$c_X^* = \frac{B - R^A L_1^1 \sigma_1^2 \left[1 - s_1 \frac{(1-\rho)}{1+\varphi}\right]}{B + R^A \sigma_1^2 \left[1 - s_1 \frac{(1-\rho)}{1+\varphi}\right]}$$

- Services should have lower coinsurance when they are more highly serially correlated over time
- The higher the savings rate adjustment for health care shocks, the less insurance is needed
- If consumers discount the future more highly than the rate of interest, then there should be more insurance

Summary of what paper shows

1. Preventive care should be covered generously because consumers will ignore premium savings in their private prevention decisions.
2. Health care goods that are positively correlated with other health spending should be more generously covered
3. Health care goods that are substitutes should be covered more generously than complements.
4. Cover services generously that are positively correlated with uncompensated losses
5. Services that are positively serially correlated over time should be covered more generously than those that are uncorrelated