Selection and Incentive Effects in Health Insurance

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Risk sharing and incentives

- Health insurance reform:
  - putting patients (more) at risk
  - decreasing level of coverage : lower demand for health *care* (incentive effect)

trade-off between risk sharing and incentives.

- coverage $\downarrow \Rightarrow$ expected cost (risk) $\downarrow$ (moral hazard)
- coverage $\downarrow \Rightarrow$ demand for *insurance* $\downarrow$
- expected cost (risk) $\downarrow \Rightarrow$ premium $\downarrow$
- premium $\downarrow \Rightarrow$ demand for *insurance* $\uparrow$

Trade off

- Terms of the trade-off :
  - coverage elasticity of risk ("moral hazard")
  - price (premium) elasticity of demand for insurance
  - coverage elasticity of demand

Asymmetries of information in health insurance

- Moral hazard: endogenous risk
  - expected cost depends on unobserved action (prevention effort)
- In health care insurance, "ex post" moral hazard:
  - demand for health *care* price elastic
  - health insurance : cost *reimbursement*
    - induces an ex post price distortion

Asymmetries of information in health insurance: a simple theory

Timing:

- Health state h is drawn from a distribution, observed by the agent (but not by us).
- Risk (some endogenous variable) x is realised (e.g., health care consumption).

We observe x and D (but not h).

First glance at the data

CSS (a major health insurance fund) in the *Canton de Vaud*
89 141 individuals (62 415 adults)
administrative claims for years 1997 to 2007.

Deductible	*230*	*400*	*600*	*1 200*	*1 500*
Average expenditure	3 474	2 648	1 872	1 327	614

Positive correlation between coverage and expenditures.
(Q: causality?)

Selection and incentive effects

Notation: $(x|y)$ the distribution of x conditional on y, $\mu_x(.|y)$ its c.d.f.
A random variable x is a **signal of bad health** if: it is observable; it is negatively related to h, *conditionally on* D.
Formally : for any D, for any $h' > h$, $(x|D,h) \succeq (x|D,h')$.
There is an **incentive effect** on x if :

$$\forall h, D' > D \ \Rightarrow (x|D,h) \succeq (x|D',h).$$

There is a **selection effect** if a higher deductible (lower coverage) reveals a better distribution of health state (a larger θ):

$$D' > D \ \Rightarrow (h|D') \succeq (h|D).$$

Lemma: separating incentive and selection effects

Let $D' > D$ be two contracts, x a signal of bad health (real-valued random variable which decreases with h) We have:

$$E[x|D] - E[x|D'] = \underbrace{\int_{\tilde{h}} \left(E[x|D,\tilde{h}] - E[x|D',\tilde{h}] \right) d\mu_h(\tilde{h}|D')}_{A(D,D')} + \underbrace{\int_{\tilde{h}} \frac{\partial E}{\partial h}[x|D,\tilde{h}] \left(\mu_h(\tilde{h}|D') - \mu_h(\tilde{h}|D) \right) d\tilde{h}}_{B(D,D')}$$

- $A(D, D') \geq 0$ if there is an incentive effect on x.
- $B(D, D') \geq 0$ if there is a selection effect: $D' > D$ reveals a better health, which induces less spendings.
- Either effect induces a negative correlation between D and X.

Need more structure

A model

- Health care good x, unit price p.
- Consumption (composite) good c, numeraire (price =1)
- exogenous income W.
- State-depedent preferences $u(c, x; h)$.
  - Ex1: $u(x, c, h) = U(c) + H(x + h)$ (separable in c and h...)
  - Ex2 (Cobb-Douglas): $u(x, c, h) = b(h) + \alpha(h) \ln(c) + (1 - \alpha(h)) \ln(x)$
    - What matters is that MRS_{xc} decreases with h...

Ex ante efficiency

$$\max_{x(.),c(.) \text{ s. t.}} E[u(x(h), c(h); h)].$$

$$E[px(h) + c(h)] \leq W$$

No ex post distorsion: $X(h, W)$ first best level.

$$\forall h, \frac{u_x}{u_c}(X(h), c(h); h) = p.$$

Full insurance: for all (h, h'):

$$u_c(X(h), c(h); h) = u_c(X(h'), c(h'); h').$$

- Note : if $u_{ch} = 0$, then First best health insurance = no insurance!

Implementation?

First best efficient allocation would be implementable with health-dependant income transfer (self-financed, $E[T(h)] = 0$):

$$T(h) = pX(h) + c(h) - W.$$

Ex post decision:

$$\max_{x, c \text{ s. t.}} u(x, c; h).$$

$$px + c \leq W + T(h).$$

$$T(h) = L(h) - E[L(h)],$$

$E[L(h)]$: insurance premium, prepaid.

$$L(h) = \underbrace{pX(h)}_{\text{health care}} + \underbrace{c(h) - E[c(h)]}_{\text{consumption insurance}}.$$

Second best insurance

BUT no such scheme (h unobservable).
Imperfect insurance $t(x)$, with copayment rate $t'(x) \geq 0$, instead of $T(h)$.
Example: deductible D, $I(x) = \max\{px - D; 0\}$; fair premium $P = E[I(x(h))]$.
Ex post:

$$\max_{x,c \text{ s. t.}} u(x, c; h).$$

$$px + c \leq W + I(x) - E[I(x)].$$

Budget constraint : $C(x) + c \leq W$, with $C(x)$: out-of-pocket expenditure (+ premium): $C(x) = px - I(x) + E[I(x)]$.
Marginal price of health care: $C'(x) = p$ if $px < D$, $C'(x) = 0$ if $px > D$; more generally, $C'(x) \neq p$ for some x: "moral hazard".

Second best insurance contract

Three distorsions:

- Price $p(1 - t')$ is too small (ex post): incentive effect.
- No coverage of consumption risk $c(h) - E[c(h)]$.
- Income transfer $t(x(h))$ may be too small or too large

If D increases, copayment t' increases: less distorsions, but less risk sharing.

Second best) optimal contract:

- depends on risk aversion and price elasticity of demand for health care
- trade off between *risk sharing* and *incentives*
- Blomqvist (1997): nonlinear contract, copayment decreases with expenditure

Empirical issue: effect of copayment on health care expenditures?

Health care: usual empirical finding:
Positive correlation between coverage and expenditures.
Causality?
Separating adverse selection and "moral hazard":

- Difficult empirical issue (esp. on cross sectional data)
- Policy issue

Econometric study of Swiss health insurance claims data.
(joint work with Lucien Gardiol and Chantal Grandchamp, University of Lausanne).

Health insurance in Switzerland: regulated competition

- Each insurance firm offers the same menu of contracts
- Insurance is mandatory, selection is prohibited.
- Premiums are independent of age, sex, health condition
- Risk adjustment scheme
- Insurance firms compete in premiums
- Premium subsidy for the poor
- + a bit of Managed Care.

The Swiss system: an economist's dream?

Each contract:

- a deductible D
- a copayment rate $\tau = 10\%$
- a cap on annual expenditure $D + 600$ Sfr.

(600 Sfr = 400 EUR)
(mean household income, 2001 : 105 000 Sfr)
Each individual faces the same menu of contracts:
$D \in \{230, 400, 600, 1200, 1500\}$.
$\rightarrow$ information on opportunity cost.

The data

CSS (a major health insurance fund) in the *Canton de Vaud*
89 141 individuals (62 415 adults)
administrative claims for years 1997 to 2000; age, sex, annual inpatient and outpatient expenditure; invalidity rent, premium subsidy, supplementary insurance (with CSS).
Annual expenditure (reference category: $D = 1500$, $x \simeq 1200$)

Deductible	*230*	*400*	*600*	*1'200*
Difference	2'860	2'034	1'258	713

Positive correlation between coverage and expenditures.
But: endogenous choice of coverage D!

Asymmetries of information: the "complete" story

Timing:

- The menu of contracts is given (no "adverse" selection).
- Agent observes θ (some information about health risk)
- Agent chooses coverage D (smaller $D=$ better coverage)
- Health state $h = \theta + \varepsilon$ is drawn, observed by the agent (but not by us).
- Risk (some endogenous variable) x is realised.

Random variable x: represents some (possibly endogenous) component of the risk. Examples: measures of health care consumption (number of visits or inpatient stays, annual expenditure,...); death.
We observe x and D (but not θ or h).

Death and the deductible: First strong evidence of selection

Presumably, no incentive effect (esp., no *positive* effect of coverage on mortality).
Raw figures (keep only individuals ages 20 to 64, who did not exit the sample except by death).

D	**n**	**number of deaths**					**death rate**
		1997	1998	1999	2000	Total	
230	12'362	75	56	58	68	257	2.0790
400	4'195	12	8	11	11	42	1.0012
$\geq$ 600	8'757	12	21	16	12	61	0.6966
Total	25'314	99	85	95	91	360	1.4221

Death and the deductible: controls

Simple logit analysis: $X = 1/0$ indicates if the individual has died or not in the four year period.

Variables (X)	Coefficients	Odds Ratio	z
Constant	-7.1000		-6.92
Gender (ref=female)	0.8376	2.3108	7.66
Age	0.0075	1.0076	0.17
Age squared	0.0007	1.0007	1.53
Deductible 230	0.6657	1.9459	3.95
Deductible $>$ 600	-0.3671	0.6927	-1.81

Further analysis: sample selection

Keep only adult men (aged over 25), who stayed with CSS over four years, did not change deductible, are not eligible to disability pension benefits, did not receive a premium subsidy.
Final data set: 7 885 individuals, four years.

Variables (n=31'540)		**Mean**	**Std-dev.**
Age in 1997		52.68	14.92
Outpatient expenditures		1'854.17	3'288.77
Frequency of inpatient costs > 0		0.09	–
Inpatient expenditures (if > 0)	*n=2'848*	6'706.22	8'537.38
Total health care costs		2'478.86	5'240.32
Rural area		0.30	–
Deductible	*230*	0.40	–
	400	0.16	–
	600	0.26	–
	1'200	0.10	–
	1'500	0.08	–
Supplementary insurance	*alternative*	0.58	–
	semi-private	0.15	–
	private	0.14	–

Structural model: individual choice.

First stage: health indicator θ observed; deductible D chosen.
Second stage: health state h is realised; health care consumption x and a composite good c are chosen.
For the individual, monetary costs associated with health care (given D):

$$M(x) = \min\{px; D + \tau(px - D); D + \tau K\}.$$

Total out of pocket costs include non monetary costs:

$$C(x; D) = M(x) + ax.$$

Second stage (**incentive effect**)

$$v(h, W; D) \equiv \max_{c,x|c+C(x;D)\leq W} (u(x, c, h))$$

Gives the (ex post) utility level v, and the health care consumption function $x(h, W; D)$.
Incentive effect: x decreases with D. Limit case: $D = +\infty$ (no insurance), $X(h, W)$ (ex post efficient).

First stage (**selection effect**)

$$\max_{D,W|W+P(D)\leq W_0} E[v(\tilde{h},W;D)|\theta].$$

Selection effect: D increases with θ, hence $(h|D)$ increases with D.

Demand for health care : incentives

Under Cobb-Douglas utility.
Second stage (incentive effect)
There exist critical values $h^1(D)$ and $h^2(D)$, and two constants $\lambda_0 > \lambda_\tau > 1$ such that:

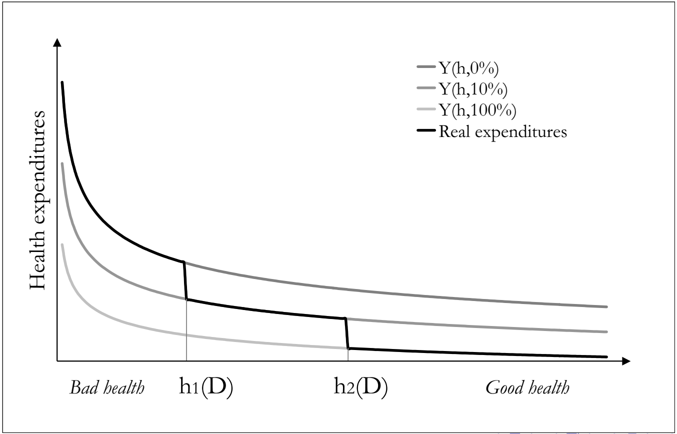
- bad health: $h < h^1(D)$, expenditures exceed the cap: $x(h, D) = X(h)\lambda_0$;
- average health: $h \in [h^1(D), h^2(D)]$, expenditures exceed deductible: $x(h, D) = X(h)\lambda_\tau$
- good health: $h > h^2(D)$, expenditures below deductible: $x(h, D) = X(h)$.

First stage: selection effect.

Increasing θ (better expected health): larger D is preferred (bunching).

We assume that, conditional on D, $(X(h)|D)$ follows a (two-step) lognormal distribution (p_D, μ_D, σ_D). If p_D, μ_D differ across D, this reveals a selection effect.

Demand for health care



Identification assumption : multiplicative incentive effect
$x(h,\tau) = X(h)\lambda_\tau$.
λ represents the incentive effect: $\lambda_0 > \lambda_\tau > 1$ is a multiplicative factor when copayment rate changes.
Empirical strategy:

$$
\begin{array}{rcl}
 & \text{proba } p & \\
x = 0 & \Rightarrow & X = 0 \\
 & \text{proba}(1-p) & \\
0 < x \leq D & \Rightarrow & x = X \\
D \leq x \leq D + K & \Rightarrow & x = D + (X - D)\lambda_\tau \\
D + K \leq x & \Rightarrow & x = D + K\lambda_\tau + (X - D - K)\,\lambda_0
\end{array}
$$

Variable	*Benchm*	*Incentive*	*Selection*	*Both*	*z-value*
λ_τ		1.6565		1.8783	*31.87*
λ_0		2.0947		2.4963	*19.03*
Mean (μ_D)					
constant	5.3923	5.4547	5.5576	5.4635	*179.91*
D400			-0.0661	0.0195	*1.06*
D600			-0.1709	0.0356	*1.84*
D1200			-0.2584	0.1567	*4.30*
D1500			-0.6914	-0.0522	*-0.80*
age	0.3437	0.2807	0.3301	0.2652	*46.97*
Variance (σ_D^2)					
constant	1.5261	1.2329	1.5960	1.2674	*45.99*
D400			-0.1006	-0.1323	*-9.72*
D600			-0.1146	-0.1894	*-14.43*
D1200			-0.0338	-0.1774	*-6.76*
D1500			0.1106	-0.0930	*-1.90*
age	-0.0556	-0.0350	-0.0597	-0.0359	*-9.89*
p					
constant	0.3742	0.3742	0.5694	0.5694	*73.42*
D400			0.0094	0.0094	*1.78*
D600			-0.0889	-0.0889	*-14.19*
D1200			-0.2996	-0.2996	*-30.82*
D1500			-0.4037	-0.4037	*-39.90*
age	0.0645	0.0645	0.0443	0.0443	*55.22*

Simulation: with estimated values of λ, compare with $D = 1500$

Deductible	*230*	*400*	*600*	*1'200*
Incentive effect	697	521	306	62
Selection effect	2'163	1'513	953	651
Observed difference	2'860	2'034	1'258	713

Differences in spendings: 1/4 incentive effect, 3/4 selection effect.

Should deductibles be increased?

- depends on risk aversion...