Selection

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Outline

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3. Application: genetic tests
4. Premium risk, community rating and risk adjustment
5. Advantageous selection

Section 1

Adverse selection with fixed coverage

Model

- fixed insurance contract, e.g. full coverage
- large heterogeneous population:
  - differ in willingness to pay for contract
  - differ in expected costs
- heterogeneity is unobserved by insurers
  (expected costs and willingness to pay are ”private information of consumers”)
- insurers set premium
- for now: insurances have no administrative costs

Question

- Who is likely to have a higher willingness to pay for insurance: those with low or high expected costs?

Demand and marginal cost

Competitive equilibrium I

- "equilibrium":
  - no market participant wants to change his behavior (stability)
  - outside prediction of market outcome with rational market participants
- consumers buy at the lowest offered premium and only if this premium is below WTP
- lowest offered premium has to *be equal or above* average costs of those consumers that buy
  (otherwise selling insurance company makes losses and would rather not sell)
- lowest offered premium has to be *equal or below* average costs of those consumers that buy
  (otherwise an insurance company could increase its profits by slightly undercutting)

Competitive equilibrium II

- if many insurers compete on premium, equilibrium premium equals average costs (”Bertrand competition” or ”perfect competition”)

$$p^* = AC_{\text{buying consumers}}$$

- possible inefficiency: too little insurance in equilibrium

Result:

- adverse selection leads to too little insurance
- insurance mandate (?)
- premium subsidy

Special cases

- no inefficiency
- complete unravelling

Gender specific premia

- suppose women tend to have lower expected costs than men
    - who will have the lower premium, if insurance companies are allowed to discriminate based on gender?
    - if insurance companies are prohibited to discriminate based on gender, who benefits? who loses?
    - does discrimination lead to a more or less efficient outcome?

Gender specific premia

- unisex tarif were introduced in Montana, US in 1983 by law
- Wall Street Journal (1987) reported the following changes in premia

	women	men
life insurance	+15%	-3%
health insurance	-13%	+28%
car insurance	+49%	-16%

Loading factors

- insurance companies have administrative costs
- MC curve is expected payout + administrative costs of the contract
- admin costs shift MC up
- "loading": difference between premium and expected payout

Results:

- not necessarily optimal to insure everyone → insurance mandate not optimal
- effects of adverse selection as before (underinsurance in equilibrium)

Evidence for self selection

- recipients of Medicare can in many parts of the US choose between traditional plan and HMO plan (limited network and benefits)
  - expenditures 6 months before enrolling in HMO: 63% of average
  - expenditures 6 months after disenrolling from HMO: 160% of average
- Ellis (1985) reports of an employer that switched from offering one insurance plan to offering 3 insurance plans with different coverage levels
  - employees choosing high coverage plan had four times as high expenditures than the one in the low coverage plan

Section 2

Screening with coverage: Rothschild-Stiglitz

Rothschild-Stiglitz Model (screening with perfect competition)

- consumers
  - two risk types: prob of loss either α_l or $\alpha_h > \alpha_l$
  - otherwise identical (utility function u with $u' > 0$ and $u'' < 0$, wealth W, loss L)
  - risk type is private information of consumer
- insurers
  - risk neutral (i.e maximize expected profits)
  - zero administrative costs
  - offer menus of coverage/premium pairs
  - many insurance companies
  - know share of high risk type in population $\gamma \in (0, 1)$

Rothschild-Stiglitz equilibrium

system of contracts, i.e. coverage/premium pairs, such that

1. every offered contract yields non-negative expected profits,
2. no insurance can increase its expected profits by offering another contract,
3. consumers maximize expected utility.

Rothschild-Stiglitz: first best (no information asymmetry)

- benchmark: risk types are known by insurances
- what is equilibrium?

Rothschild-Stiglitz: curves and slopes I

Aside:

Implicit function theorem

Let the function $p(q)$ be implicitly defined by the equation

$$F(p, q) = 0$$

where F is a continuously differentiable function. Then,

$$p'(q) = -\frac{\partial F / \partial q}{\partial F / \partial p}$$

at all points where $\partial F / \partial p \neq 0$.

Example (IFT)

$3p - 4q = 0$ implicitly defines the function

$$p(q) =$$

Check $p'(q)$ according to IFT and by directly differentiating $p(q)$.

Rothschild-Stiglitz: curves and slopes II

- *iso-profit curve* for profit level $\bar{\pi}$
  - all (q, p) combination leading to profit $\bar{\pi}$
  - profits: $\pi = p - \alpha q L$
  - iso- profit: $p(q|\pi = \bar{\pi}) = \bar{\pi} + \alpha q L$ with slope αL
- *indifference curve* for expected utility $\bar{u}$
  - all (q, p) combinations leading to expected utility $\bar{u}$
  - exp. utility: $\mathbb{E}[u] = \alpha u(W - p - (1-q)L) + (1-\alpha)u(W-p)$
  - slope indifference curve via implicit function theorem:

$$p'(q|\mathbb{E}[u] = \bar{u}) = \alpha L \frac{u'(W - p - (1-q)L)}{\alpha u'(W - p - (1-q)L) + (1-\alpha)u'(W-p)} \geq \alpha L$$

for $q \leq 1$ (with strict inequality if $q < 1$) and rearranging gives

$$p'(q|\mathbb{E}[u] = \bar{u}) = L \frac{u'(W - p - (1-q)L)}{u'(W - p - (1-q)L) + \frac{1-\alpha}{\alpha}u'(W-p)}$$

and therefore slope indifference curve higher for higher α

Rothschild-Stiglitz: curves and slopes III

important features to remember:

- through a (q, p) point the slope $p'(q)$ of the indifference curve is higher for higher risk types
- for $q < 1$: through a (q, p) point the slope $p'(q)$ of the indifference curve of type α is higher than the slope of the isoprofit line of type α
- for $q = 1$: through a (q, p) point the slope $p'(q)$ of the indifference curve of type α equals the slope of the isoprofit line of type α

Rothschild-Stiglitz: second best (no pooling)

- high risk type has higher demand for coverage
- single crossing:
  - in coverage, premium diagram, h has a steeper indifference curve
- pooling equilibrium: both risk types buy the same contract

Result:

- pooling equilibrium does not exist

Rothschild-Stiglitz: second best (separating equilibrium)

- one contract for each risk type and each prefers his contract
- properties in a separating equilibrium:
  - as h is more eager to buy insurance, he has more coverage (higher q) in equilibrium
  - competition leads to zero profits

Results:

- equilibrium construction:
  - h gets contract where his zero profit line intersects full insurance
  - l gets contract where h's indifference curve through h's contract intersects l's zero profit line
- first best contract for h
- underinsurance for l

Rothschild-Stiglitz: second best (non-existence of equilibrium)

- if γ small, there exists a pooling contract with positive profits from the above constructed "equilibrium"
  $\rightarrow$ no equilibrium exists in this case
- other equilibrium concepts for this case (Wilson 1977, Miyazaki 1977, Spence 1978, Netzer and Scheuer 2014)

Rothschild-Stiglitz: minimum coverage level

- suppose a law makes it impossible to offer coverage below some threshold $\bar{q}$
- how does this affect equilibrium?

Section 3

Application: genetic tests

Genetic tests: possible regulatory frameworks

- genetic tests can be used to determine risk (but usually not perfectly)
- what is the right regulatory framework:
  - private information: test results (if existing) are private information of insured (and insurance policies cannot depend on them)
  - voluntary disclosure: test results can be presented to insurer but do not have to be presented
  - mandatory disclosure: existing results have to be disclosed
  - laissez faire: insurers can (but do not have to) require (additional) tests

Genetic tests: model

model:

- same as Rothschild-Stiglitz but without test consumers do not know their risk type and have an average type $\bar{\alpha} = \gamma\alpha_h + (1-\gamma)\alpha_l$

equilibria under different scenarios:

1. benchmark: test is impossible
2. everyone is tested and results are disclosed to insurers (mandatory disclosure)
3. everyone is tested and results are private

Genetic tests:

Proposition

With risk averse consumers, expected utility of consumers is in (1) higher than in (2), and in (2) higher than in (3).

Genetic tests: how to think about risk

- two kind of risk:
  - risk of having bad genetics
  - risk of falling ill given your genetic predisposition
- without tests:
  - combination of both risks is insured
- with tests:
  - only risk conditional on genetic disposition is insured
  - (risk averse!) consumer bears risk of bad genetic disposition

Genetic tests: (partial) misunderstandings

- ''genetic tests make health insurance impossible because insurance is about unpredictable risks''
- ''accurately predicting risks will simplify the calculation of premia; that's great for insurers''
- ''voluntary disclosure is best for consumers as they then can use the test to get a better insurance when the test is favorable and they simply do not use the test otherwise''

Genetic tests: trade-off

- make tests available to insurer
    - consumers bare risk of bad genetic test (double punishment in case of bad genetic disposition)
- keep tests private
    - increased adverse selection

Genetic tests: some (in)efficiencies

- some risk factors can lead to prevention efforts or – cheaper – early treatment
- test taking is costly
  - tests for risk of untreatable diseases

Genetic tests: models of endogenous information acquisition I

- suppose consumers decide themselves whether to take test at cost $c \geq 0$ and afterwards choose an insurance contract (or stay uninsured)
- insurers cannot verify whether consumer did (not) take a test
- equilibria in different scenarios
  1. $c = 0$ and private information
  2. $c = 0$ and voluntary disclosure
  3. $c > 0$ and voluntary disclosure
  4. $c > 0$ and private information

(for details, see Doherty and Thistle, Journal of Public Economics, 1996, 63, pp. 83-102)

Genetic tests: models of endogenous information acquisition II

- let genetic test results be private information
- insurer(s) offer menu of contracts
- consumer observes menu, then decides *how much* money/effort to spend on genetic tests to get a better idea of his own risk, then decides which contract to buy

Results:

- the more the offered contracts differ, the higher the incentives to acquire information
- more similar contracts $\rightarrow$ less informed consumers $\rightarrow$ higher profits
- distort h contract as well to make contracts more similar! (additional inefficiency)

(source: Lagerlöf and Schottmüller, International Economic Review, 2018, 59(1), pp. 233-255)

Section 4

Premium risk, community rating and risk adjustment

Premium risk: basics

- premium (and coverage) can depend on information health insurer has
  - age, chronical illness, ZIP code etc.
- consumer faces risk of higher premium due to future change in characteristic
  - getting older, becoming chronically ill, moving to bad ZIP code etc.

Premium risk: simple model

- 2 periods
- risk of loss L in period 1 is α_l
- risk of loss L in period 2 is
  - α_l with probability λ
  - $\alpha_h > \alpha_l$ with probability 1-λ
- perfect competition of profit maximizing insurers
- period 2 risk type is observable in period 2 by everyone but not in period 1

Equilibrium:

- premium/coverage in period 1:
- premium/coverage in period 2 for α_l:
- premium/coverage in period 2 for α_h:
- risk averse consumer suffers from premium risk:

Premium risk: Long term contracts

- insurance contract covering both periods at premium
  - premium in period 1: $\alpha_l L$
  - premium in period 2: $(\lambda\alpha_l + (1-\lambda)\alpha_h)L$
- potential problems:

Premium risk: Guaranteed renewal

- against an up front fee of $[(\lambda\alpha_l + (1-\lambda)\alpha_h) - \alpha_l]L$ the insurer offers the option to renew contract at first period premium $\alpha_l L$
- potential problems:

Premium risk: premium insurance

- (other) insurers offer full insurance against health premium increase at price $[(\lambda\alpha_l + (1-\lambda)\alpha_h) - \alpha_l]L$
- advantage over guaranteed renewal:
- potential problems:

Premium risk: community rating

- regulation: all insured pay the same premium, $\alpha_l L$ in period 1 and $(\lambda\alpha_l + (1-\lambda)\alpha_h)L$ in period 2, that must not depend on risk type
  - problem:
- community rating + mandatory insurance
  - problem:
- community rating + mandatory insurance + open enrollment
  - problem:
- community rating + mandatory insurance + open enrollment + regulated coverage
  - problem:
- community rating + mandatory insurance + regulated coverage + open enrollment + single payer (NHS, Scandinavia)
  - problem:
- community rating + mandatory insurance + regulated coverage + open enrollment + risk adjustment (Netherlands?)

Risk adjustment

- "cream skimming" as problem:
  - insurers avoid high cost consumers and try to attract low cost consumers (how?)
- risk adjustment tries to eliminate this incentive
  - internal transfer payments from insurances with low risk insured to insurances with high risk insured
  - risk estimates based on observable characteristics (gender, age, chronically ill etc.)
  - if well designed, transfer exactly compensates additional cost
  - level playing field –> more intense competition
  - risk factors should be outside of the control of the insurer to avoid manipulability
- problems of community rating + mandatory insurance + regulated coverage + open enrollment + risk adjustment:

Risk adjustment: how good is prediction?

- 1997, 1998 data from large German insurer (800.000 insured)
- % of variance explained by the following covariates

	concurrent exp	prospective exp
age and gender	3.2%	3.2%
age, gender and invalid status	5.1%	4.5%
above + HCC	37%	12%

HCC = hierarchical coexisting conditions

(source: Behrend et al. 2007. European Journal of Health Economics 8 (1): 31–39.)

- from 1996 to 2001 German risk adjustment was based on age, gender, invalid status and income
- since 2009, detailed system of hierarchical coexisting conditions

Risk adjustment: how good is prediction?

Comparison of R^2 from various risk adjustment models from six papers

Study	Newhouse et al., 1989	Van Vliet and van de Ven, 1992	Fowles, Weiner, et al 1996[b]	Physician Payment Review Commission 1994	Pope et al, 1998a	Lamers, 1998b
Sample population	US Privately Insured	Netherlands	US HMO enrollees	US, Medicare	US Medicare	Netherlands sickness fund
Sample period	1974-1979	1981-82	1991-1993	1991-1992	1991-1993	1991-1994
Sample size	N=7,690	N = 20,000	N = 5780		N = 10,893	N=10,570
Age/Sex	0.016	0.028	0.058	0.016	0.007	0.038
All socioeconomic[a]		0.037				
Functional status[a]					0.0252	
Self reported chronic conditions[a]		0.071	0.111	0.032	0.0274	
Self reported health[a]	0.028			0.03	0.0311	
Short-Form 36 like[a]			0.111	0.033	0.0405	
Prior year spending[a]	0.064				0.0413	
Comprehensive survey[a]		0.114		0.062	0.0418	0.060
Diagnosis based[a]	0.045		.124[c]		0.0727[d]	0.080[e]
All variables[a]	0.09			0.07	0.0785	0.086

(source: Cuyler and Newhouse, eds. van de Ven and Ellis, Handbook of Health Economics, pp. 755-845, 2000)

Section 5

Advantageous selection

Empirics

- adverse selection requires that consumer has and uses information about his health status that the insurer does not have
- (premium risk required insurer to have and use information on consumer's health status)
- long term care insurance
- elderly sample (average age 78), US, 1995-2000
- 16% enter nursing home, 11% have long term care insurance
- survey in 1995 asks
    - "Of course nobody wants to go to a nursing home, but sometimes it becomes necessary. What do you think are the chances that you will move to a nursing home in the next five years?"
    - average answer 18%

Empirics: Explanations

- wealth
  - poorer people are covered by Medicaid –> buy less insurance
  - poorer people have higher risk
- "risk aversion"
  - risk averse people are more likely to buy insurance
  - risk averse people have lower risk

Advantageous selection

- variable A is
  - negatively correlated with risk
  - positively correlated with insurance purchase (or vice versa)
- can turn positive correlation between risk and insurance purchase around
  - people with lower risk buy insurance
  - "advantageous selection"

Other observations:

- Hemenway reports on risk aversion
  - in a hospital 7% were uninsured but 46% of motorcyclists with accidents
  - another hospital: 27% of helmeted motorcyclists uninsured but 41% of unhelmeted
- prevention channel
- Fang, Keane and Silverman find negative correlation in medigap market and can attribute it to wealth and cognitive ability (not risk aversion)

Advantageous selection: model with fixed coverage

Fixed coverage model:

- difference between demand and cost function captures risk premium
- suppose higher cost consumers have low risk premium
- order consumers according to (i) willingness to pay for insurance or (ii) expected costs