FGS Chapter 7

Insurance

Key aspect of all of health care markets.

Simple example

100 people

One person becomes sick which costs $2000

That one person is much worse off.

Instead, suppose each person pays $20
20*100 = $2000
This money can go to the one person who is sick.

Each persons income remaining to purchase other goods falls by $20.

Loss due to illness is avoided.

Key implicit assumptions:
   a) information: illness and loss are verifiable
   b) risk pooling: enough people are around so that the law of large numbers applies.

Now we can model more formally.
Expected Utility Theory

Random variables: possible values and their associated probabilities.

(0, -2000) a lottery, for a random variable

\[ x = \text{gain or loss} \]
\[ p = \text{probability of } x \]

\[ E(x) = 0 (1-p) + -2000 \cdot p \]
\[ = -2000p \quad \text{Expected value of lottery} \]

Before, \( p = .01 \) \( E(x) = -20. \)

So lottery in the previous example had an expected value of \(-$20\)

Suppose now that \( p = \frac{1}{2}, x =100 \)

Consider the following choice

$50 for sure versus \( (0, 100) \)

\( \frac{1}{2} \quad \frac{1}{2} \)

(two alternatives both with the same expected value.)

Which would you prefer?
Preferences

~ indifferent to

☐ is preferred to

τ is at least as good as

$50 ☐ (0, 100)

½ ½

Could find the value of p where consumers are indifferent

$50 ~ (0, 100)

1-p  p for p =
EC387 in-class exercise
Fill out values of p in each of the following lotteries which reflects your own indifference between these gambles.

$50 for sure ~ (0, 100)
    1-p  p   for p = ____

$30 for sure ~ (0, 100)
    1-p  p   for p = ____

$70 for sure ~ (0, 100)
    1-p  p   for p = ____

$500 for sure ~ (0, 1000)
    1-p  p   for p = ____

$300 for sure or ~ (0, 1000)
    1-p  p   for p = ____

$700 for sure or ~ (0, 1000)
    1-p  p   for p = ____

-$500 for sure or ~ (0, -1000)
    1-p  p   for p = ____

-$300 for sure or ~ (0, -1000)
    1-p  p   for p = ____

-$700 for sure or ~ (0, -1000)
    1-p  p   for p = ____

You do not need to fill out this form if you do not want to. Results will be turned in anonymously and tallied, and used in class. Results have no bearing on grading for this course.
Utility function

Utility

Marginal Utility

W = Wealth

Wealth
Risk premium

$X$ with certainty $\sim (0, 100) \quad \frac{1}{2} \quad \frac{1}{2}$

Expected value of lottery is $50$.

So $50 - X$ is risk premium.

$r$ should be $> 0$ for risk averse people.

More generally,

$U(wealth + expected \ value \ of \ lottery - risk \ premium) = \ \text{Expected Utility (wealth + lottery)}$

$U(W + 50 - r) = \frac{1}{2} U(W+0) + \frac{1}{2} U(W + 100)$

$r = \text{risk premium}$

In the in class assignment,

$50 \sim (0, 100)$

$p = .52$

$E(x) = .52*100 = 52$

$\Rightarrow \quad EU(W+50) = .48 \ U(W + 0) + .52 \ U(W+100)$

$\Rightarrow \quad EU(W+52 -(52-50)) = .48 \ U(W + 0) + .52 \ U(W+100)$

$\Rightarrow \quad r = 52 - 50 = $2
Demand for insurance: primarily motivated by RISK AVERSION

Other possible motives
(tax subsidy to consumption of health care)
(reduced transaction costs)

Have to be careful about how losses are measured L = P*Q.
Does consumer get to choose quantity?
Are prices exogenous?

Example:

John’s wealth $20,000
Illness: lose $10,000
Chance of illness p = .1

No insurance:

EU = .9 U(20,000) + .1 U(10,000)

Now can buy insurance at the following rate:

For each $100 of coverage, pay $10

(Actuarially fair insurance)

How much insurance should he buy?
Johns insurance problem. \( W = 20,000 \) \( L = 10,000 \) \( p = .1 \)
For each $100 of coverage, pay $10

No insurance:
EU = \(.9 \ U(20,000) + .1 \ U(10,000)\)

Buy $100 insurance
EU  = \(.9 \ U(20000-10) - .1 \ U(20000-10-10000+100)\)
   = \(.9 \ U(19,990) - .1 \ U(10,090)\)

Buy $500 insurance
EU  = \(\)
   = \(.9 \ U(19,950) + .1 \ U(10,450)\)

Buy $1000 insurance
EU  = \(\)
   = \(.9 \ U(19,900) + .1 \ U(10,900)\)

Buy $10000 insurance
EU  = \(\)
   = \(.9 \ U(19,000) + .1 \ U(19,000)\)
   = \(\ U(19000)\)
Demand for insurance depends on

- Distribution of losses
- Wealth
- Loading factor
- Attitudes toward risk (more or less risk averse)
- Taxes
- Other risks you face

Supply of insurance
MB, MC measured in utility units

Q = quantity of insurance
Supply of insurance

Insurance companies do not provide actuarially fair insurance, since they have to cover costs and earn profits on their business.

They also have administrative costs, such as the cost of enrolling each person.
Johns Utility Calculations

Utility function:
\[ W = 20000 \]
\[ U = 1000 \ln(x) \]
Loss = 10000
\[ p = 0.1 \]
load = 0

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Wealth | Utility | Marginal Utility
Same example with insurance loading costs

Johns Utility Calculations
Utility function:
\[ W = 20000 \]
\[ U = 1000 \times \ln(x) \]
Loss = 10000
\[ p = 0.1 \]
load = 0.2

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Plot of MB versus MC

MB, MC

Quantity of Insurance

Marg
Marg
FGS Chapter 7 continued.

**Supply of Insurance**

Insurance adds to total costs since insurers have to cover their administrative costs and their profits.

Loading costs of insurance work like a tax, introducing a wedge between the supply and the demand for insurance.

The optimal decision for the consumer with loading costs is to buy less than full insurance.

\[ p = .5 \] = probability of getting ill
\[ P_1 \] = price of medical care when sick
\[ Q_1 \] = quantity of medical care when sick
\[ \lambda \] = loading factor

Premium = \[ \Pi = (1+\lambda) \ p \cdot P_1 \cdot Q_1 \]

Moral Hazard problem: Expected value of loss is influenced by the presence of insurance.

May affect p or P or Q
Effects of coinsurance and deductibles in a demand framework. (lots of figures)

Effects of secondary insurance such as Medigap

Deadweight loss from insurance.

Technological change also responds to insurance coverage.

Prices charged by doctors may also react to insurance!
So lots of moral hazard problems:
  Consumer takes fewer precautions
  When sick, \( Q \) increases because of low copay
    Increase in \( Q \) for things already purchased
    Increase in \( Q \) for things not already purchased
  Prices may increase because of insurance
  Technological change may react to insurance